

EUROPEAN PATENT APPLICATION

published in accordance with Art. 158(3) EPC

Application number: **79901540.9**

Int. Cl.³: **E 02 D 17/13**

Date of filing: **14.11.79**

Data of the international application taken as a basis:

International application number: **PCT/JP 79/00292**

International publication number: **WO 80/01087 (29.05.80 80/12)**

Priority: **21.11.78 JP 159442/78**
21.11.78 JP 159443/78
21.11.78 JP 159444/78
21.11.78 JP 159445/78
21.11.78 JP 159446/78

Date of publication of application: **07.01.81**
Bulletin 81/1

Designated Contracting States: **DE FR GB NL**

Applicant: **KABUSHIKI KAISHA TAKENAKA KOMUTEN, 27, Honma-chi 4-chome Higashi-ku, Osaka-shi, Osaka 541 (JP)**
 Applicant: **SANWA KIZAI KABUSHIKI KAISHA, 10, Kayaba-cho 2-chome Nihonbashi, Chuo-ku, Tokyo 103 (JP)**

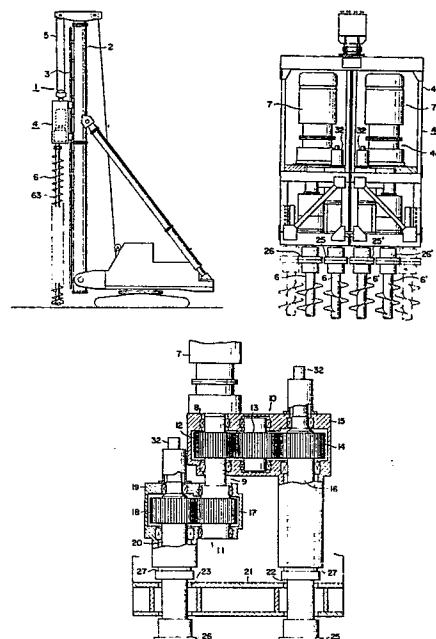
Inventor: **MIYAGUCHI, Masao, 1-14-1, Sendagaya, Shibuya-ku, Tokyo 151 (JP)**
 Inventor: **TANIFUJI, Fuminobu, 1359, Yonamoto, Yachiyo-shi, Chiba 276 (JP)**
 Inventor: **EBINE, Mitsuo, 5-5-16, Nakashizu, Sakura-shi, Chiba 285 (JP)**

Inventor: **YAMADA, Shigeru, 4-14-5, Nakashizu, Sakura-shi, Chiba 285 (JP)**
 Inventor: **NAKAMURA, Takayuki, 3-6-47, Minami-Shinagawa, Shinagawa-ku, Tokyo 140 (JP)**
 Inventor: **FUJIWARA, Masahiko, 3-22-9, Koenji-Minami, Suginami-ku, Tokyo 166 (JP)**
 Inventor: **SATO, Mitsutoshi, 11-18, Hibarigaoka, Kashiwa-shi, Chiba 277 (JP)**
 Inventor: **UCHIZAKI, Iwao, 3-9-15, Minami-Yukigaya, Ota-ku, Tokyo 145 (JP)**
 Inventor: **WADA, Hideo, 278-3, Itanakashinden, Sanbu-machi, Sanbu-gun, Chiba 289-12 (JP)**
 Inventor: **MURAI, Toshio, 8-1-3, Asahi-cho, Kashiwa-shi, Chiba 277 (JP)**
 Inventor: **SUZUKI, Akio, 11-17, Hibarigaoka, Kashiwa-shi, Chiba 227 (JP)**
 Inventor: **YAMAMOTO, Kazuhisa, 3-41-17, Kamimeguro, Meguro-ku, Tokyo 153 (JP)**

Representative: **Boon, Graham Anthony, Elkington and Fife High Holborn House 52/54 High Holborn, London, WC1V 6SH (GB)**

54 EARTH AUGER.

57 An apparatus for driving an earth auger of the type which simultaneously excavates a plurality of vertical holes via a plurality of excavating rods such as auger screws or the like to thereby form a continuous wall under the ground by mortar charged into the vertical holes, the apparatus enabling transmission of driving force to the respective excavating rods from a sole drive source by making variable the distance between the axes of the excavating rods aligned in parallel. This device comprises two drive gears provided on a motor drive shaft, two gear trains formed by meshing the gear on an output shaft, which shaft is connected with the two drive gears, wherein the two gear trains are supported respectively within gear boxes to carry the drive motor on the upper stage (motor side) gear box and to rotatably support the lower stage gear box on the drive shaft to thereby allow the distance between the output shafts to be varied. Thus, even if auger screws of different outer diameters are connected to one another, an excessive gap will never form between the screws, nor will the screws interfere with one another.



EP 0 020 779 A1

DESCRIPTION

TITLE OF INVENTION

Earth Auger

TECHNICAL FIELD

5 This invention relates to an earth auger having a plurality of drill rods such as auger screws, for use in foundation stabilization and in the construction of water cutoffs, shoring, and like continuous walls in the ground, and more particularly to a drive assembly for the drill
10 rods, to support means for a drive mechanism included in the drive assembly, to means for holding constant the spacing between the drill rods and for preventing their oscillation, and to bearing means for use therewith.

BACKGROUND ART

15 The earth auger has been used as a means for the construction of continuous walls such as water cutoffs and shoring in the ground, by a method such that mortar or soil-mortar piles are formed in the bores created by the earth auger, with the piles being placed tangent to each
20 other to form a continuous wall.

The earth auger of usual construction drills bores with a single auger screw and is therefore highly inefficient for the construction of the noted continuous walls. Recently, therefore, earth augers have been in use which
25 have a plurality of auger screws arranged in juxtaposition. The auger screws are driven simultaneously for creating a row of bores in the ground, and mortar or soil-mortar piles are formed in the bores to provide a continuous wall.

There have been proposed an example of earth augers
30 of the above conventional character in which several auger screws are fixedly mounted at unvariable spacings from each other, and another example in which a plurality of auger screws, each with its own drive assembly, are juxtaposed with variable spacings between the screw shafts.
35 The former has problems arising when applications demand the use of auger screws of different diameters. For example, when the auger screws are changed to those of

smaller diameters, undue spacings will exist between the auger screws. A row of bores formed by such auger screws will have soil portions left uncut therebetween, which must be removed after the boring operation, with a consequent decrease in operating efficiency. A change to auger screws of greater diameters would result in the mutual interference between the screw blades of the adjacent screws. Thus, the former type of auger screw has a disadvantage in that it permits the use of auger screws of only limited diameters.

In the latter type, on the other hand, each auger screw has its own drive assembly, so that the entire drive system is of great size and weight. The number of auger screws to be juxtaposed is therefore limited, and the spacings between the screw shafts can be varied only within narrow limits. Thus, the latter type of auger screw is also incapable of efficient construction of continuous walls.

Heretofore, for supporting the drive mechanism of an earth auger, a bracket has been integrally secured by welding to the back of the holder of the drive mechanism, which houses a motor, speed reducer, etc. The bracket has been provided with several pairs of slides, which are in engagement with guide tubes mounted on the front side of a leader mast, for up-and-down motion along the leader mast.

Since the slides are affixed as above to the bracket welded to the back of the drive mechanism in accordance with the conventional means for supporting the auger drive mechanism, the earth auger can be mounted only on those leader masts whose guide tubes have the same spacing as that between each pair of slides. In mounting the drive mechanism on a leader mast having guide tubes spaced greater than each pair of slides, there may be contemplated the use of spacers between the mating surfaces of the bracket and the slides, thereby increasing the actual distance between the slides. If the spacers are of any great thickness, however, the connections between bracket and

slides will become insecure. Such spacers can therefore be hardly employed in practice in view of the danger during drilling operation.

In the above described multiple rod type earth auger, having a plurality of drill rods such as auger screws in juxtaposition for constructing continuous walls in the ground by simultaneously creating as many bores therein, the top ends of the auger shafts are coupled to the auger drive mechanism and are thereby maintained at constant spacings. The lower portions of the drill rods, however, are free, so that the spacings therebetween are subject to change. As a consequence, the bores drilled by such drill rods, and therefore the mortar or soil-mortar piles formed in the bores, tend to have irregular spacings therebetween. Such piles are highly undesirable in the construction of continuous walls.

For holding constant the spacings between the drill rods, with or without screw blades, the multiple rod type earth auger has been equipped with rod spacing holding means interconnecting the drill rods at their mid-points. The conventional holding means comprise sleeves rotatably mounted on the mid-positions of the respective drill rods and integrally joined by connecting plates. The spacings between the sleeves are fixed, however, thus necessitating the use of different holding means each time the spacings between the drill rods are to be changed.

There have been known means for preventing the oscillations of the drill rods, which are mounted on the front side of the lower portion of the leader mast for holding the drill rods so as to permit changes in the spacings therebetween as required by working conditions. With the known oscillation preventing means, however, the guide holders holding the drill rods are fixed, so that different oscillation preventing means are also required for changes in rod spacings.

Further, in the above rod spacing holding means, the auger shafts are rotatably inserted into and supported by

their bearing portions, so that the bearing portions must be protected against the intrusion of soil. The bearings heretofore used for this purpose have simply been those having laminates of synthetic resin layers or oilless metal on their contact surfaces. Permitting easy soil intrusion, such bearings tend to hamper the smooth rotation of the auger shafts and to invite ready wear of the bearings themselves and the auger shafts.

DISCLOSURE OF INVENTION

10 The present invention, which has been made with a view to solving the foregoing problems, concerns a drive assembly for an earth auger which is capable of driving a plurality of drill rods from a single drive source and which permits changes in the center-to-center distances between the drill rods to enable drilling operation with the use of auger screws of various diameters. The invention also seeks to provide support means permitting the drive assembly to be mounted on guide tubes on the front side of an earth auger tower in spite of variations in the spacing between the guide tubes; means for holding constant the spacings between, and for preventing the swinging of drill rods such as auger screws by locking them to each other, and bearing means effective to prevent soil intrusion between the mating parts of the drill rods and the means for holding constant the spacings therebetween.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a side elevational view of a preferred form of the earth auger in accordance with the present invention;

Fig. 2 is an enlarged plan view of the drive mechanism of the earth auger;

Fig. 3 is a front elevational view of the drive mechanism;

Fig. 4 is a vertical sectional view of the drive mechanism;

Fig. 5 is a partial, front elevational view, partly in section, of the drive mechanism;

Fig. 6 is a plan view of an example of means for

securing output shafts;

Fig. 7 is an enlarged, partial sectional view of the means of Fig. 6;

Figs. 8(A) and 8(B) are views explanatory of the way
5 in which the center-to-center distances between the output shafts are adjusted;

Fig. 9(A) is an enlarged plan view of support means for the drive mechanism;

Fig. 9(B) is a front elevational view of the support
10 means;

Fig. 10(A) is a plan view of modified support means;

Fig. 10(B) is a front elevational view of the modified support means;

Figs. 11 and 12 are enlarged plan views of further
15 modified support means;

Fig. 13 is an enlarged front elevational view of means for holding constant the spacings between the drill rods;

Fig. 14(A) is a sectional view taken along the line A-A of Fig. 13;

Fig. 14(B) is a sectional view showing the means of
20 Fig. 13 with the spacing between the drill rods altered;

Fig. 15 is a plan view of means for preventing oscillation;

Fig. 16 is a front elevational view of the means of
25 Fig. 15;

Fig. 17 is a view showing the way in which a guide holder is mounted;

Fig. 18 is a sectional view taken along the line B-B of Fig. 17; and

Fig. 19 is a sectional view, partly in elevation, of
30 an example of bearing means for use in the rod spacing holding means.

BEST MODE OF CARRYING OUT THE INVENTION

As shown in broad outline in Fig. 1, the earth auger
35 1 includes a drive assembly 4 suspended by wire rope 5 for up-and-down motion, by an unshown winch, along tubular guides 3 (hereinafter referred to as guide tubes) extending

longitudinally on the front side of a leader mast 2. The drive assembly 4 has attached thereto a plurality (four in the illustrated embodiment) of drill rods in the form of auger screws 6 and 6'.

5 The drive assembly 4 comprises a drive mechanism 4a and a holder 4b. As seen in Figs. 3 to 5 inclusive, the drive mechanism 4a has two motors 7 and 7' for the respective pairs of auger screws 6 and 6'. The motors 7 and 7' drive the auger screws 6 and 6' in alternately opposite
10 directions.

As shown in Fig. 5, each drive system is such that the motor 7, for example, has its output shaft 8 coupled to a drive shaft 9. The drive shaft 9 is coupled to a first auger screw drive system 10 and a second auger screw
15 drive system 11 with an appropriate spacing therebetween in the vertical direction. The second auger screw drive system 11 is free to rotate with respect to the drive shaft 9.

The first auger screw drive system 10 comprises a
20 drive gear 12 fixedly mounted on the drive shaft 9, an idle gear 13 meshing with the drive gear 12, and an output gear 14 meshing with the idle gear 13. These gears 12, 13 and 14 are rotatably mounted within a gear box 15, and the output gear 14 is secured to an output shaft 16.

25 The second auger screw drive system 11 comprises a drive gear 17 fixedly mounted on the drive shaft 9, and an output gear 18 meshing with the drive gear 17. These gears 17 and 18 are rotatably mounted within a gear box 19, and the output gear 18 is secured to an output shaft
30 20.

Extending through slots 22 and 23 formed in the bottom 21 of the drive mechanism 4a, the output shafts 16 and 20 are provided with means 24 for securing the output shafts 16 and 20 to the bottom 21. The output shafts 16
35 and 20 have couplings 25 and 26 at their lower ends for detachable connection to the upper ends of the auger screws 6.

As shown in an enlarged section in Fig. 7, the securing means 24 include a base plate 29 having a pawl 28 in engagement with a step 27 formed in the lower portion of each of the gear boxes 15 and 19 (only one shown for simplicity). Each base plate 29 is secured to the bottom 21 by means of bolts 31 passing through selected ones of bolt holes 30 formed in the bottom 21.

Thus, the gear boxes 15 and 19 of the first and second auger screw drive systems 10 and 11 are displaceable, while being coupled together by the drive shaft 9, in accordance with the positions of the output shafts 16 and 20. The output shafts 16 and 20 can therefore be secured with the spacing therebetween selected as desired. The reference numeral 32 indicates a swivel.

The following is an operational description of the various means set forth in the foregoing. In order to adjust the spacings between the auger screws 6 and 6', the bolts 31 of the securing means 24 are loosened and removed, and the output shafts 16 and 20 may be moved away from or toward each other along the slots 22 and 23 by use of a crane or other suitable means. In this manner, as shown in Fig. 8(A) or (B), the gear box 15 will rotate about the output shaft 16, with the consequent displacement of the drive shaft of the motor, whereas the gear box 19 will rotate about the motor drive shaft, with the consequent displacement of the axis of the output shaft.

After the positions of the output shafts 16 and 20 have been determined, the base plates 29 of the securing means 24 are secured to the bottom 21 of the drive mechanism 4a by inserting the bolts 31 into the bolt holes 30 in the bottom 21. The pawls 28 of the base plates 29 will then engage the steps 27 of the gear boxes 15 and 19, thereby rigidly holding the output shafts 16 and 20 in position.

After thus setting the spacings between the output shafts 16 and 20, and 16' and 20', the auger screws 6 and 6' can be connected to the respective output shafts. Then,

upon rotation of the motors 7 and 7', the output shaft 8 of the motor 7, on one hand, will rotate the drive shaft 9. The rotation of the drive shaft 9 results in the rotation of the output shaft 16 via the drive gear 12, 5 idle gear 13 and output gear 14, and of the output shaft 20 via the drive gear 17 and output gear 18, in the opposite directions, thus driving the pair of auger screws 6. The other pair of auger screws 6', on the other hand, are driven in an identical manner. The mechanism for 10 driving the auger screws 6' is identical in construction with the mechanism for driving the auger screws 6, so that its constituent parts will be identified by priming the reference characters used to denote the corresponding parts explained in the foregoing.

15 It is possible in this manner to drill bores at desired spacings.

The movements of the output shafts 16, 16', 20 and 20' may be accomplished by fluid actuated cylinders, horizontal feed screw mechanisms, or the like. In these cases 20 the securing means may be changed to those which lock the cylinders or screw mechanisms.

Further, although the illustrated embodiment comprises two separate drive mechanisms mounted side-by-side within the holder for driving four auger screws, only one drive 25 mechanism may be employed in an earth auger having two auger screws, and three drive mechanisms may be mounted within a holder for driving six auger screws.

Next to be described is the support means by which the drive assembly 4 comprising the drive mechanism 4a and 30 holder 4b is mounted on the guide tubes 3 of the leader mast 2.

With reference to Fig. 9(A), a vertical guide groove 41 is formed centrally in the back 40 of the holder 4b of the drive assembly 4. Received in the guide groove 41 is 35 a ridge 42 on a bracket 43, which is removably mounted on the holder by bolts 44 and nuts 44'. The bracket 43 is formed by securing a pair of side plates 46 to a base

plate 45 in right angular relationship. A pair of inwardly directed slides 47 are fastened to the side plates 46 by bolts 48 and nuts 48'.

5 The slides 47 are in engagement with the guide tubes 3 mounted on the leader mast 2 with a suitable spacing L therebetween, so that the drive assembly 4 may travel up and down along the leader mast 2.

10 For mounting the drive assembly 4 on a leader mast 2' of Fig. 10(A), having a pair of guide tubes 3' with a spacing greater than that of the guide tubes shown in Fig. 9(A), the bracket 43 is detached from the holder back 40 by loosening the bolts 44 and nuts 44' in the state of Fig. 9(B). There is then attached to the holder back 40 of the drive assembly 4 a bracket 43' having a pair of
15 slides 47' with a spacing equal to the spacing L' between the guide tubes 3' of the leader mast 2'. The new bracket 43' can be positively mounted in alignment with the holder by the guide.

20 As a modification of the mating guide means on the holder back 40 and bracket 43, a groove 41' may be formed in the front surface of the bracket 43, and a ridge 42' may be formed in the holder back 40, as shown in Fig. 11. Further, as shown in Fig. 12, grooves 41" may be formed in both of the holder back 40 and bracket surface 43, and a
25 key 49 may be inserted into the rectangular space formed by the grooves.

The support means according to the invention are applicable to drop hammers, diesel hammers, soil stabilizers, and any such machine to be moved up and down along leader
30 masts.

The following is a description of means for holding constant the spacings between the drill rods such as auger screws and means for preventing their oscillatory motion.

35 With reference to Fig. 13, a pair of vertically spaced flanges 50 and 51 are formed on each of the drill rods 6 and 6' in selected positions of its lower portion, and an annular groove 52 is formed between each pair of

flanges. Rotatably fitted in each groove 52, via a bearing member 56 of oilless metal or the like, is a sleeve 55 having upper and lower flanges 53 and 54 corresponding to the flanges 50 and 51. Each sleeve 55 has on its outer surface a projection 57 in the form of a vertical plate directed toward the adjacent sleeve. The projection 57 has formed therein a plurality (two in the illustrated embodiment) of rows of bolt holes 58 arranged in the direction in which the drill rods 6 are juxtaposed. The opposed pair of projections 57 are interconnected by two plate-shaped connectors 59, with bolts 61 tightened after being passed through bolt holes 60 formed in the connectors 59 and through selected ones of the bolt holes 58 in the projections 57. 62 indicates O-rings sealing the joints between the drill rods 6 and the sleeves 55, and 63 indicates screw blades on the drill rods 6.

The operation of the above embodiment will now be explained.

If, while the drill rods 6 are held by the rod spacing holding means as in Figs. 13 and 14, a necessity arises for changing the center-to-center distances between the drill rods, the connectors 59 are removed from the projections 57 by loosening the bolts 61. After making the desired change in the center-to-center distance between the drill rods, the bolts 61 are tightened after passing them through the selected ones of the bolt holes 58 in the projections 57 and the bolt holes 60 in the connectors 59, as shown in fig. 14(B), thereby rigidly holding the drill rods 6 at the desired center-to-center distance.

Preferably, the bolt holes 58 in the projections 57 should be formed in several rows in consideration of expected center-to-center distances.

Although the projections 57 and connectors 59 are bolted together in the above embodiment, pins or other means may be employed for this purpose.

Figs. 15 to 18 inclusive illustrate the means for preventing the oscillations of the drill rods. A rear frame

66 is mounted by pins 67 on the front side of a holder frame 65 mounted on the guide tubes 3 of the leader mast 2 by mounting members 64 and 64. At the opposite ends of the rear frame 66, front frames 68 are pivotally mounted each at one end by a pin 69 for opening and closing movements from the center to the sides. The other ends of the front frames 68 are coupled together by a pin 70. A hollow rod guide frame is thus formed. A multiplicity of bolt holes 71 are formed in the tops of the frames 66 and 68 and in the front and rear sides of their lower portions. Pairs of front and rear rod guide holders 72 are secured by bolts 73 passing through the bolt holes 71. 74 indicates collars on the inside surfaces of the guide holders 72; 75 indicates a lever for use in coupling together the frames 68; and 76 indicates platforms.

The operation of the above device will now be explained.

The rod guide holders 72 are first secured to the rear frame and front frames 68 by the bolts 73, in positions determined by the spacings between the drill rods 6. Then, with the pins 69 removed, the front frames 68 are opened to a desired degree, and the drill rods 6 are inserted into the respective rod guide holders 72 from above. The lever 75 is then manipulated to interconnect the front frames 68 and lock them by the pins 69. The drill rods 6 are held by the respective guide holders 72 upon completion of the above operation.

The relative positions of the rod guide holders 72 can be altered with each change in the spacings between the drill rods 6. The above operation will be performed more efficiently by making use of the platforms 76. The oscillation preventing means may be suspended from the drive assembly by wires, while being attached to the guide tubes of the leader mast.

The following is the description of bearing means suitable for application to the means for holding constant

the spacings between the drill rods shown in Figs. 13, 14(A) and 14(B).

In Fig. 19, which is a half sectional view of an example of the bearing means, 80 indicates a joint section male shaft of each drill rod 6.

A stepped recess is formed in the outer surface of the end portion of the joint section male shaft, and a joint section male sleeve 81 is fitted over the recessed portion so as to provide an annular recess 82 between the step and the opposed end of the sleeve 81. At the upper and lower ends of this recess 82 there are integrally provided seal bearing members 84 having inwardly directed sealing grooves 83 formed therein. A bearing member 85 of oilless metal or the like is fitted between the seal bearing members, and a fixed bearing 87 having sealing grooves 86 formed in its upper and lower ends is rotatably mounted therebetween.

The sealing grooves 83 in the seal bearing members 84 and the sealing grooves 86 in the fixed bearing 87 are opposed to each other to provide sealing chambers 88 and 89. The inside surfaces 90 bounding the sealing chambers 88 and 89 are tapered, lessening in radius from the center toward the sides.

Movably mounted in the sealing chambers 88 and 89 are sealing rings 91, 92, 93 and 94 of hardened steel or like material of high hardness and wear resistance. Each pair of sealing rings 91 and 92, or 93 and 94, have slide portions 95 and 96 at their outer edges which are in sliding contact with each other. The outside surfaces 97, 98, 99 and 100 of the sealing rings 91, 92, 93 and 94 are tapered parallel to the tapered surfaces 90 defining the sealing chambers 88 and 89. O-rings 101 are interposed between the tapered surfaces 97, 98, 99 and 100 and the tapered surfaces 90 defining the sealing chambers 88 and 89.

The seal bearing members 84 and the fixed bearing 87 have bevelled surfaces 102 and 103 disposed opposite to

each other so as to diverge outwardly. An O-ring 104 is press-fitted in each of the V-shaped grooves defined by the bevelled surfaces 102 and 103.

The fixed bearing 87 has formed therein radial grease
5 holes 105 in communication with through-holes 106 formed in the bearing member 85. Grease can thus be supplied to the sliding surfaces of the bearing member 85 and the recessed portion 82 and into the sealing chambers 88 and 89. The fixed bearing 87 has discharge openings 107 form-
10 ed in its end portions for the discharge of the injected grease, and these are sealably closed by blind plugs. A connector 109 is secured to the outside surface of the fixed bearing 87, for connection to the adjacent fixed bearing, whereby the bearing portions are held at a con-
15 stant spacing.

Such being the construction of the bearing means, the adjacent auger shafts restrain each other by the fixed bearings 87, so that the drill rods 6 can be maintained at constant spacings as they drill into the ground.

20 The auger screws 6 rotate with the surfaces of the recessed portions 82 in sliding contact with the bearing members 85 of oilless metal or the like.

Although the loosened material in the drilled bores may tend to enter the noted rotative portions, the O-rings
25 104 fitted in the V-shaped grooves defined by the bevelled surfaces 102 and 103 of the seal bearing members 84 and the fixed bearings 87 seal the joints to prevent the intrusion of the foreign material. Even if the loose material somehow enters, the O-rings 101 in the sealing chambers 88
30 and 89 prevent it from reaching the sliding surfaces of the bearings 87 and the drill rods 6.

INDUSTRIAL APPLICABILITY

According to this invention, two drive gears are mount-
ed at a suitable axial spacing on the drive shaft coupled
35 to each motor, and the drive gears are meshed with the respective output gears fixedly mounted on the output shafts whose lower ends are coupled to the auger shafts. The two

gear trains are mounted within the separate gear boxes. The upper (motor side) gear box has the drive motor mounted thereon, whereas the lower gear box is supported for rotation about the drive shaft, thereby making
5 the spacing between the output shafts variable. The output shafts can be secured to the holder at any desired spacing. Thus, by angularly displacing the gear boxes and fixing them at selected positions, any desired spacing can be established between the output shafts, so that
10 the spacing between the auger screws coupled to the output shafts can be adjusted as desired. Moreover, since the gear trains remain in constant mesh regardless of the displacements of the output shafts, each motor can drive two auger screws smoothly and without any trouble.

15 As for the means for supporting the earth auger drive assembly, the bracket having the slides is removably fastened to the back of the drive mechanism holder, so that the drive mechanism can be mounted on leader masts having guide tubes of varying spacings, merely by changing the bracket. Further, the bracket can be positively
20 mounted in alignment with the holder by virtue of the guide on the holder back, so that the slides and the guide tubes are protected from rapid wear due to the misalignment of the bracket. Thus, the support means is of high
25 practical utility.

Further, in the means for holding constant the spacings between the drill rods of a multiple-rod auger, the sleeves are rotatably fitted over the mid-portions of the drill rods, and the projections extend from the sleeves toward each other, each projection having several rows of holes
30 formed therein in the direction in which the drill rods extend. The spacing between any two adjacent drill rods is held constant with the connectors fastened to the projections by means of bolts or the like received in the selected holes
35 of the opposed pair of projections. The spacings between the drill rods can be readily altered by passing the bolts or the like through the holes in the connectors and the

selected holes in the projections and then by tightening them. The holding means has high practical utility, in comparison with the prior art which required the use of different means with each change in the spacings between the drill rods.

Also, the oscillation preventing means of the multiple-rod auger is of such construction that the rod guide frame is mounted on the front side of the lower portion of the leader mast, with the rod guide frame carrying a plurality of rod guide holders so as to permit movement in the direction in which the drill rods are juxtaposed. Thus, when the spacings between the drill rods are changed, the rod guide holders may be simply moved to and locked in required positions. The oscillation preventing means has high practical utility, in comparison with the prior art which required the use of different means with each change in the spacings between the drill rods.

Further, the bearing means has the advantage of preventing the intrusion of the loose material into the rotary portions in the ground and thus maintaining them in smooth rotation.

CLAIMS

1. An earth auger for simultaneously drilling a plurality of bores with a plurality of drill rods such as auger screws and for forming a continuous wall in the ground by mortar poured into the bores, comprising a drive mechanism having two gear trains formed by two drive gears mounted at a suitable longitudinal spacing on a drive shaft coupled to a motor and by output gears meshing with the respective drive gears and each fixedly mounted on an output shaft to be connected at its lower end to an auger shaft, the gear trains being rotatably mounted within respective gear boxes, the upper (motor side) gear box having the drive motor mounted thereon, the lower gear box being supported for rotation about the drive shaft, thereby making the spacing between the output shafts variable, the output shafts being adapted to be secured to a holder at any desired spacing, and a plurality of drill rods coupled to and extending downwardly from respective output shafts of the drive mechanism.

2. An earth auger as claimed in claim 1, further comprising support means characterized in that a bracket is removably secured to the back of the holder of the drive mechanism while being centered by guide means, and that slides are secured to the bracket for engagement with guide tubes of a leader mast.

3. An earth auger as claimed in claim 1, further comprising rod spacing holding means wherein sleeves are rotatably fitted over shaft portions of the drill rods, wherein the sleeves have projections extending toward the adjacent sleeves, each projection having formed therein a plurality of holes arranged in the direction in which the drill rods are juxtaposed, and wherein a connector is fastened to the projections by bolts or the like received in the holes formed therein, thereby holding constant the spacing between the drill rods.

4. An earth auger as claimed in claim 1, further comprising oscillation preventing means wherein a drill rod

guide frame is mounted on the front side of the lower portion of a leader mast, and wherein a plurality of drill rod guide holders are mounted on the guide frame so as to be movable in the direction in which the drill rods are juxtaposed.

5
10
15
20
25

5. An earth auger as claimed in claim 3, further comprising bearing means characterized in that an annular recess of a required width is formed in the shaft portion of each drill rod, that seal bearing members having inwardly directed sealing grooves formed therein are integrally provided at the ends of the recess, that a bearing member of oilless metal or the like is fitted in the recess, that a fixed bearing having inwardly directed sealing grooves formed in its opposite ends is rotatably mounted between the seal bearing members, that a floating seal comprising sealing rings, O-rings and grease is provided in each of sealing chambers formed by the opposed sealing grooves of the seal bearing members and sealing grooves of the fixed bearing, that an O-ring is fitted in each of V-shaped grooves defined by outer, junction surfaces of the seal bearing members and the fixed bearing, and that the fixed bearing is engaged with a non-rotary member or, in a multiple-rod auger, connected to an adjacent fixed bearing of the same construction.

CLAIMS (AMENDED).

1. An earth auger for simultaneously drilling a plurality of bores with a plurality of drill rods such as auger screws and for forming a continuous wall in
5 the ground by mortar poured into the bores, wherein a drive mechanism is formed which has two gear trains formed by two drive gears mounted at a suitable longitudinal spacing on a drive shaft coupled to a motor and by output gears meshing with the respective drive gears
10 and each fixedly mounted on an output shaft to be connected at its lower end to an auger shaft, the gear trains being rotatably mounted within respective gear boxes, the upper (motor side) gear box having the drive motor mounted thereon, the lower gear box being supported
15 for rotation about the drive shaft, thereby making the spacing between the output shafts variable, wherein the output shafts extend through slots formed in a holder so as to extend in such directions that the output shafts can be moved toward and away from each other, wherein
20 securing means is provided for securing the gear boxes to the holder in desired positions, and wherein drill rods are coupled to the respective output shafts of the drive mechanism.

2. An earth auger as claimed in claim 1, further
25 comprising support means characterized in that a bracket is removably secured to the back of the holder of the drive mechanism while being centered by guide means, and that slides are secured to the bracket for engagement with guide tubes of a leader mast.

30 3. An earth auger as claimed in claim 1, further comprising rod spacing holding means wherein sleeves are rotatably fitted over shaft portions of the drill rods, wherein the sleeves have projections extending toward the adjacent sleeves, each projection having formed therein
35 a plurality of holes arranged in the direction in which the drill rods are juxtaposed, and wherein a connector is fastened to the projections by bolts or the like received

in the holes formed therein, thereby holding constant the spacing between the drill rods.

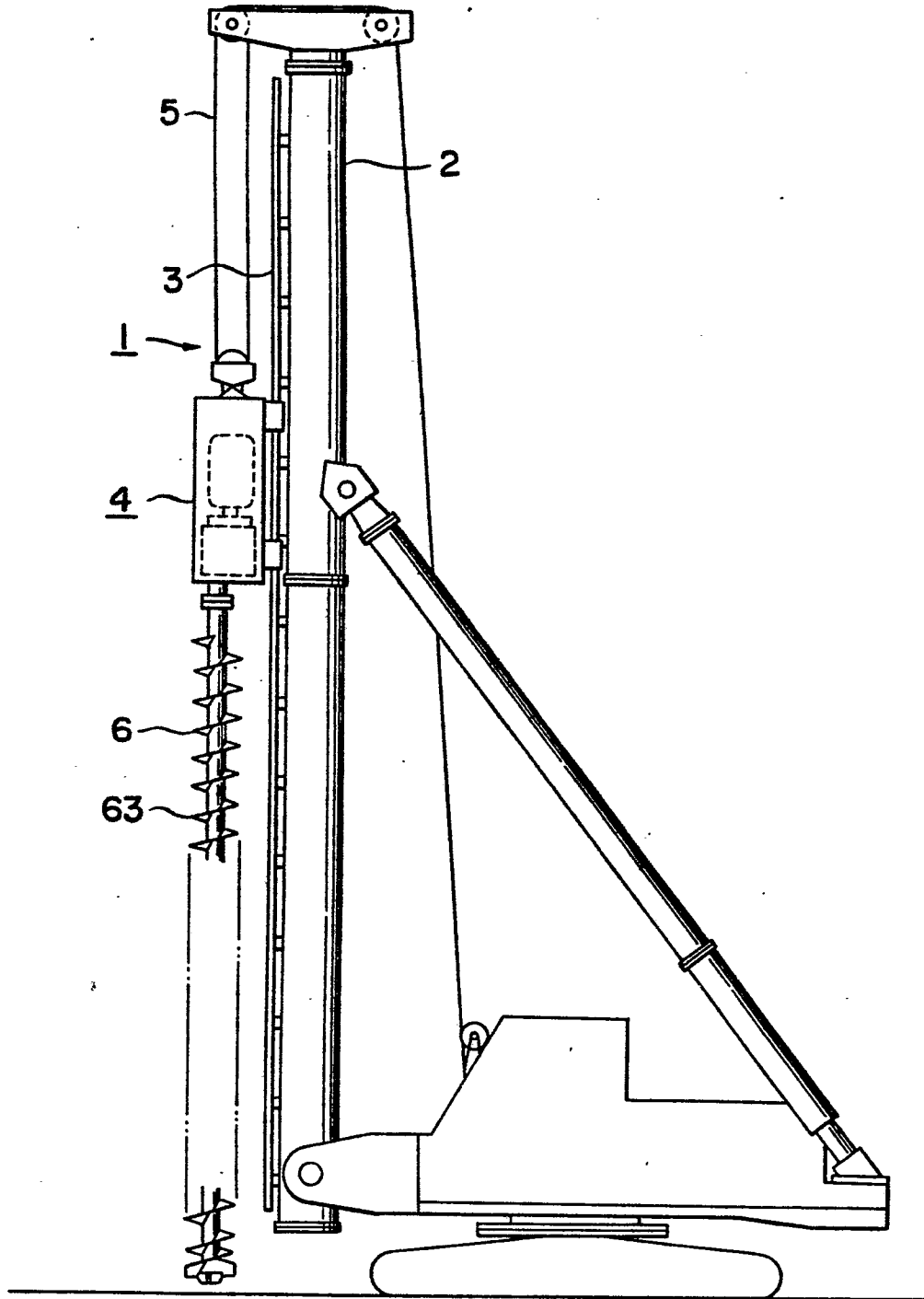
4. An earth auger as claimed in claim 1, further comprising oscillation preventing means wherein a drill
5 rod guide frame is mounted on the front side of the lower portion of a leader mast, and wherein a plurality of drill rod guide holders are mounted on the guide frame so as to be movable in the direction in which the drill rods are juxtaposed.

10 5. An earth auger as claimed in claim 3, further comprising bearing means characterized in that an annular recess of a required width is formed in the shaft portion of each drill rod, that seal bearing members having inwardly directed sealing grooves formed therein are integrally
15 provided at the ends of the recess, that a bearing member of oilless metal or the like is fitted in the recess, that a fixed bearing having inwardly directed sealing grooves formed in its opposite ends is rotatably mounted between the seal bearing members, that a floating seal
20 comprising sealing rings, O-rings and grease is provided in each of sealing chambers formed by the opposed sealing grooves of the seal bearing members and sealing grooves of the fixed bearing, that an O-ring is fitted in each of
25 V-shaped grooves defined by outer, junction surfaces of the seal bearing members and the fixed bearing, and that the fixed bearing is engaged with a non-rotary member or, in a multiple-rod auger, connected to an adjacent fixed bearing of the same construction.

1/15

0020779

FIG. 1



2/15

FIG. 2

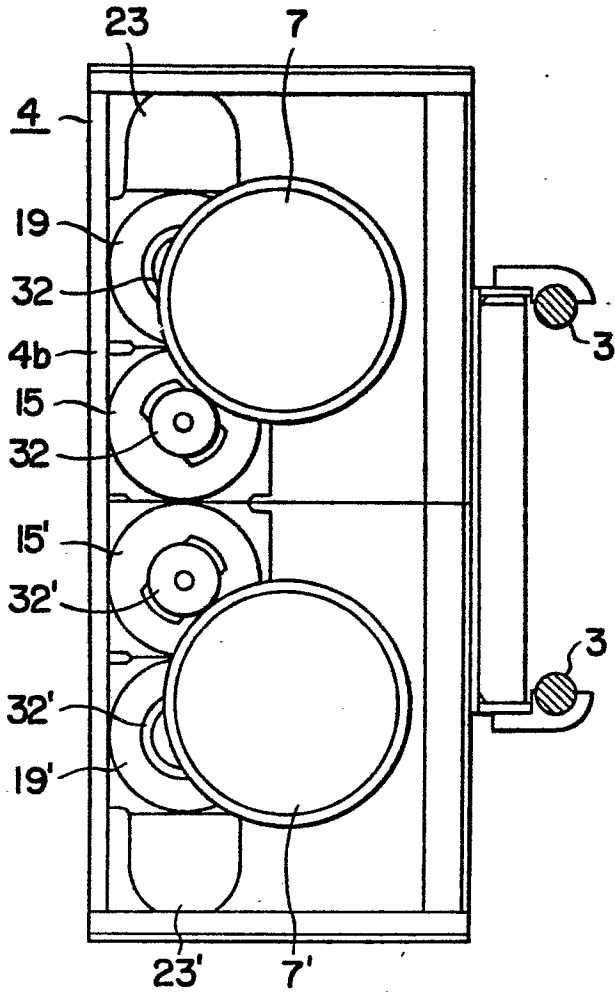


FIG. 3

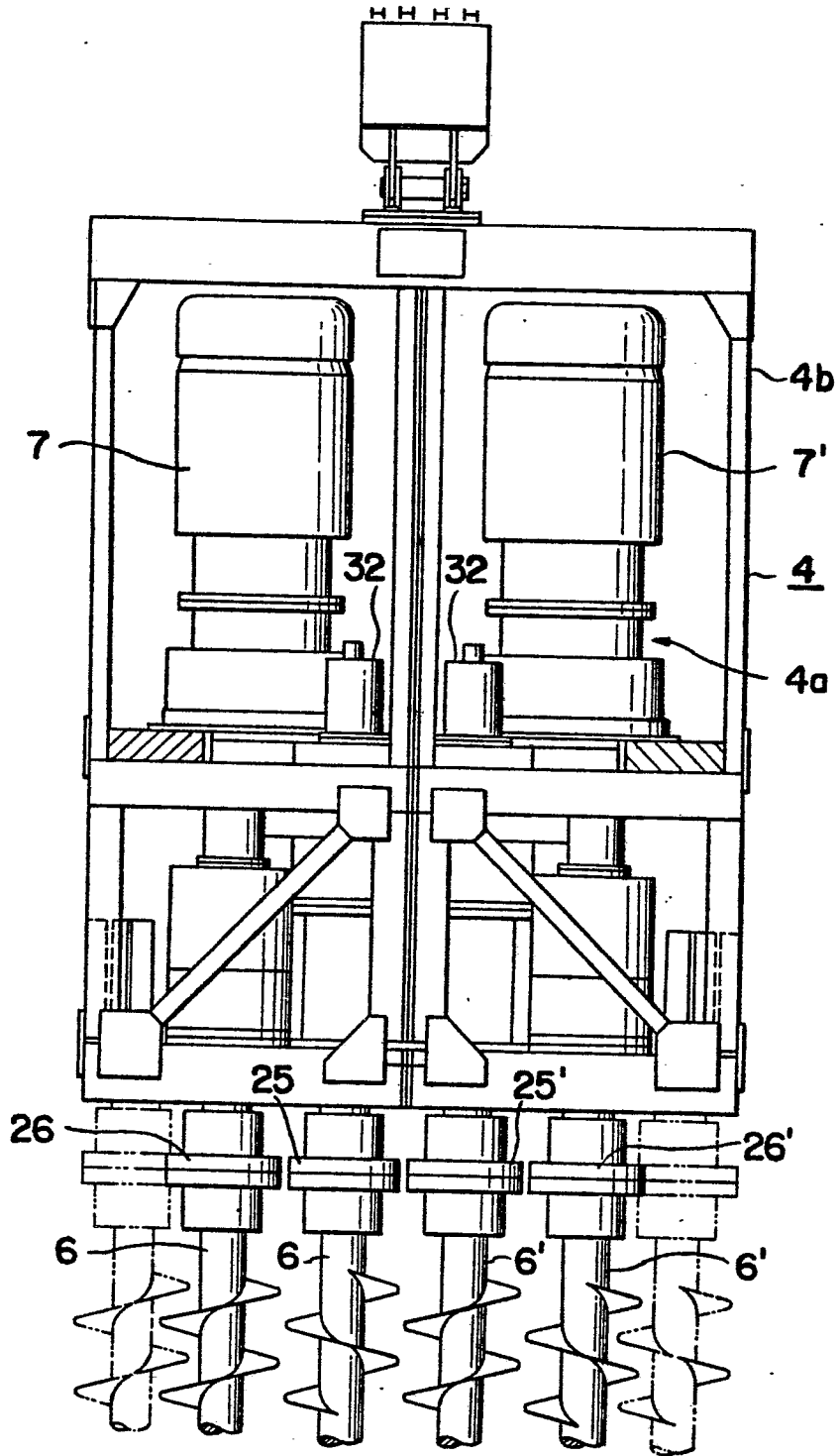


FIG. 4

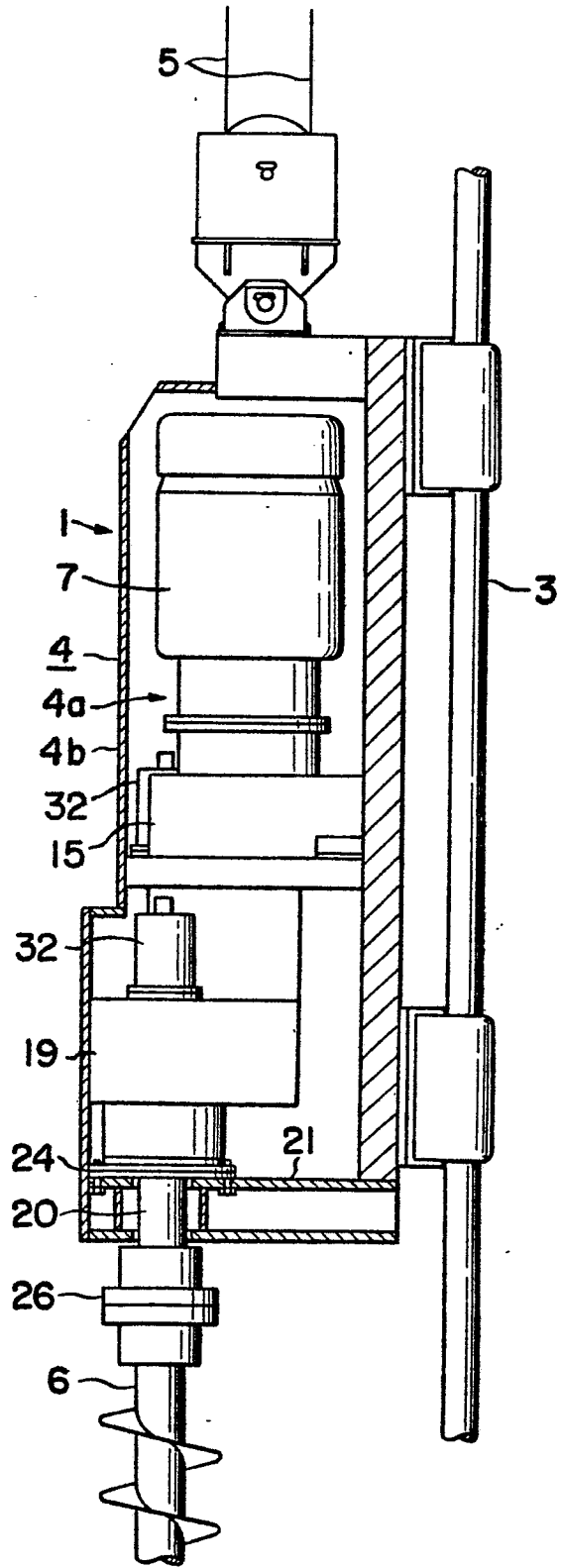


FIG. 5

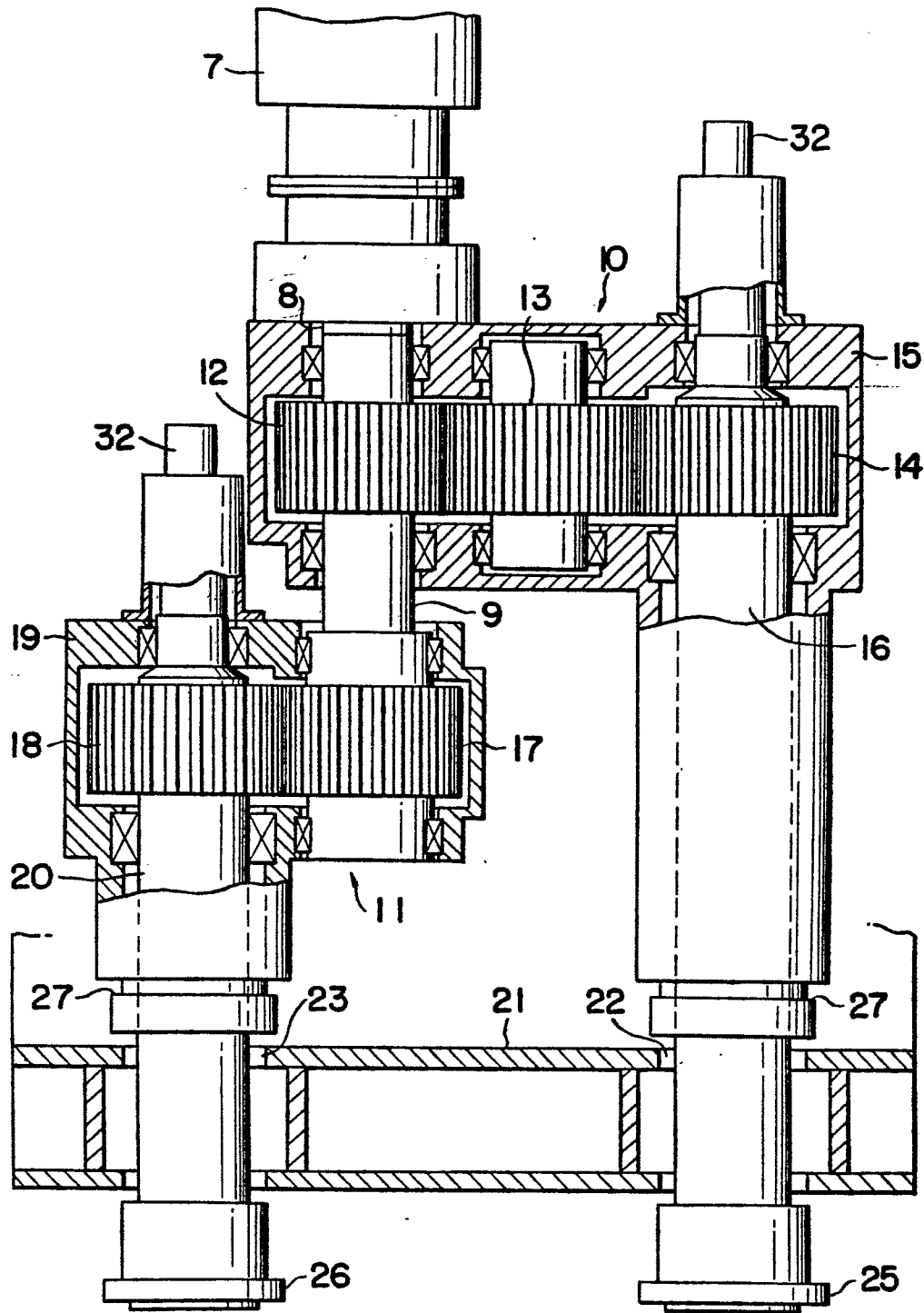


FIG. 6

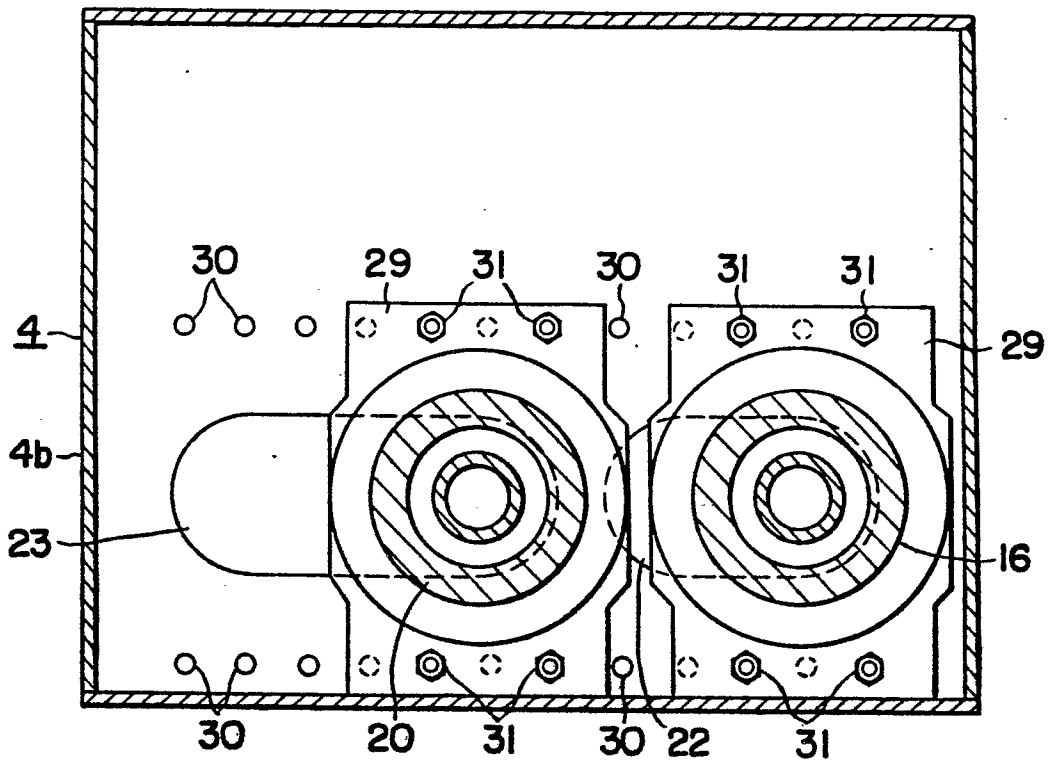


FIG. 7

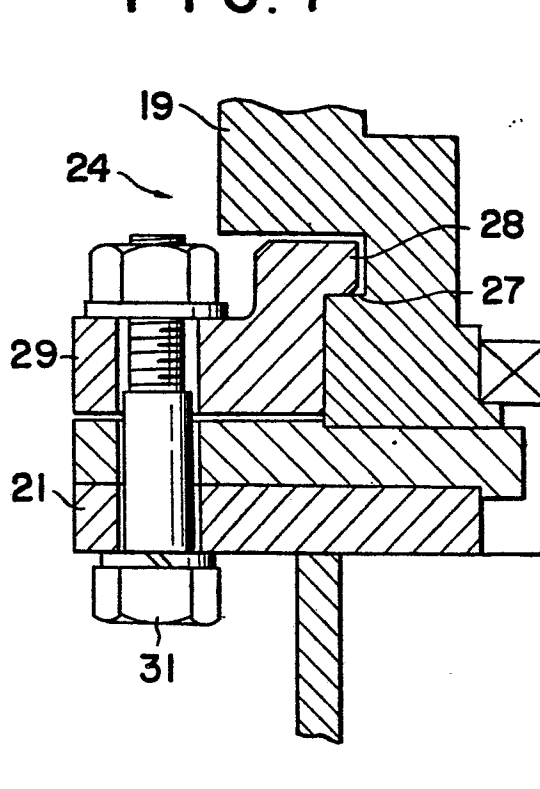


FIG. 8(A)

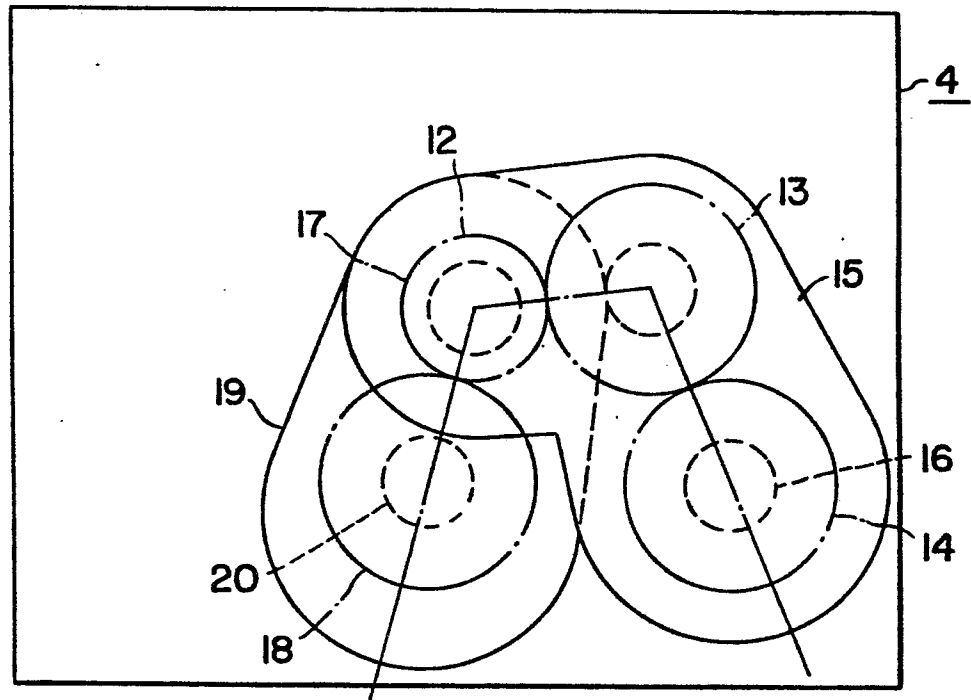
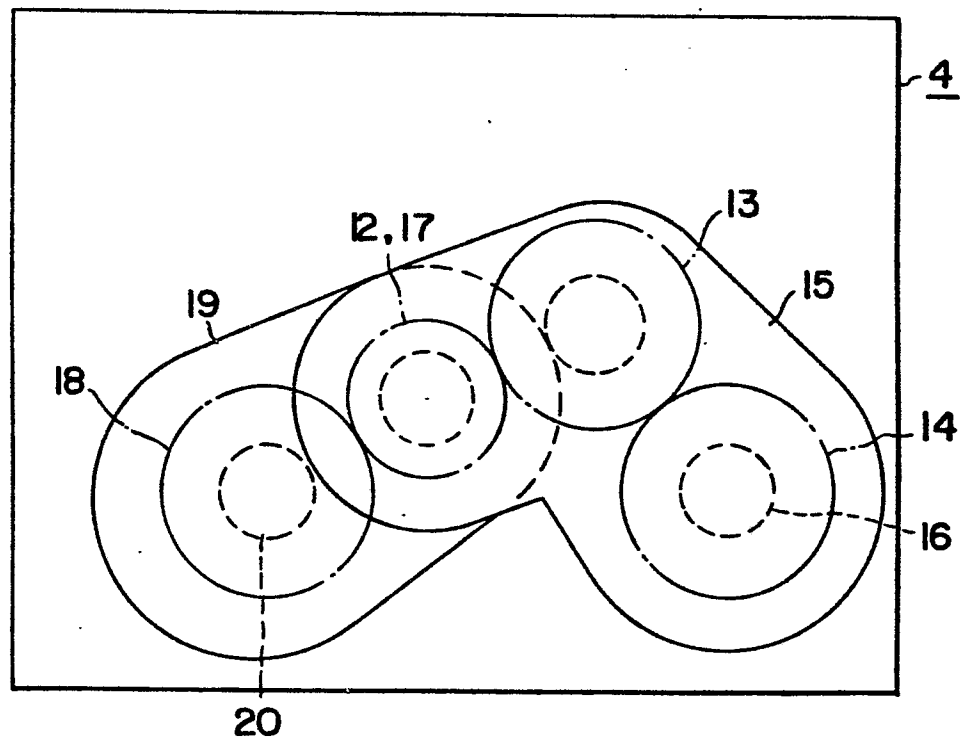


FIG. 8(B)



8/75

0020779

FIG. 9(A)

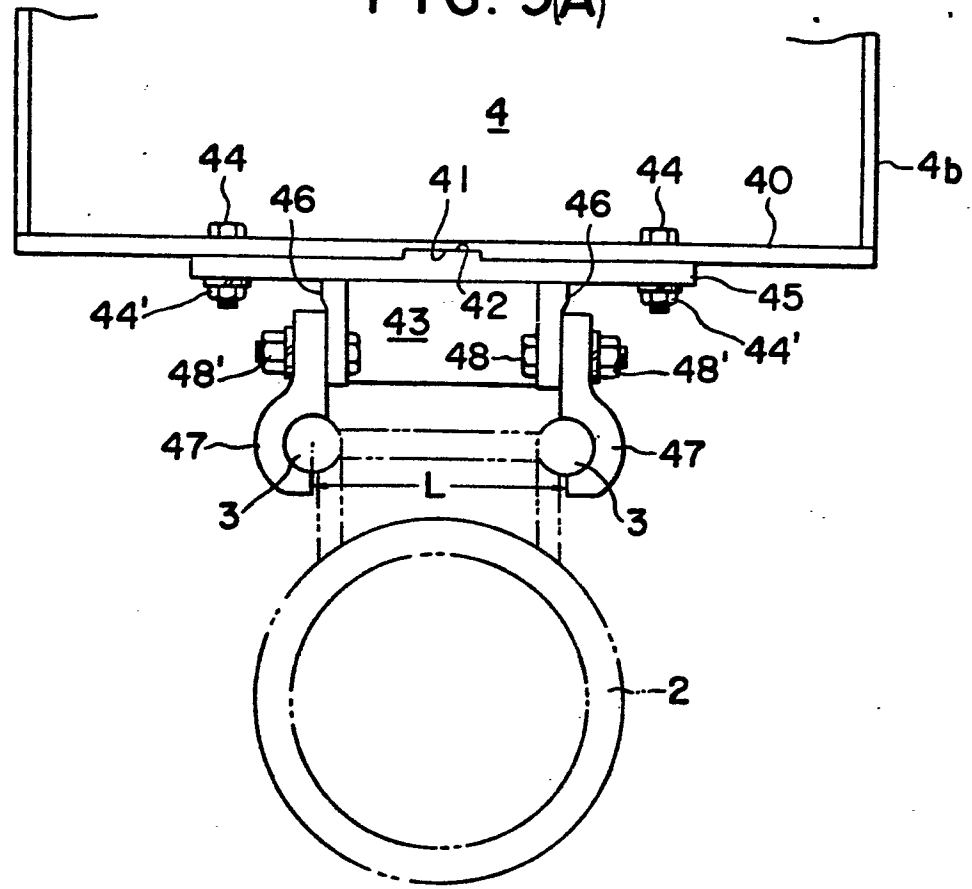
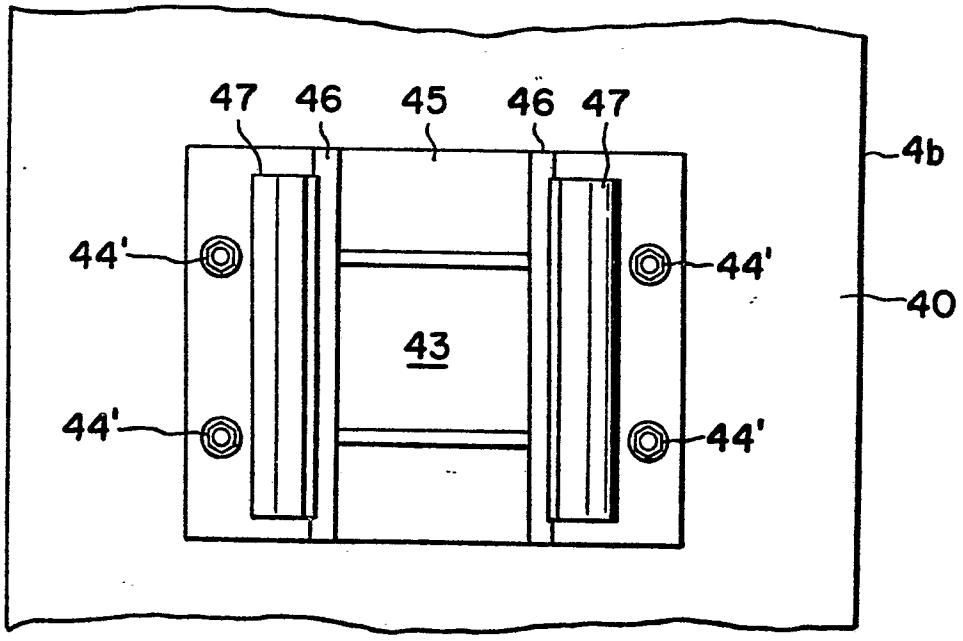


FIG. 9(B)



9/15

0020779

FIG. 10(A)

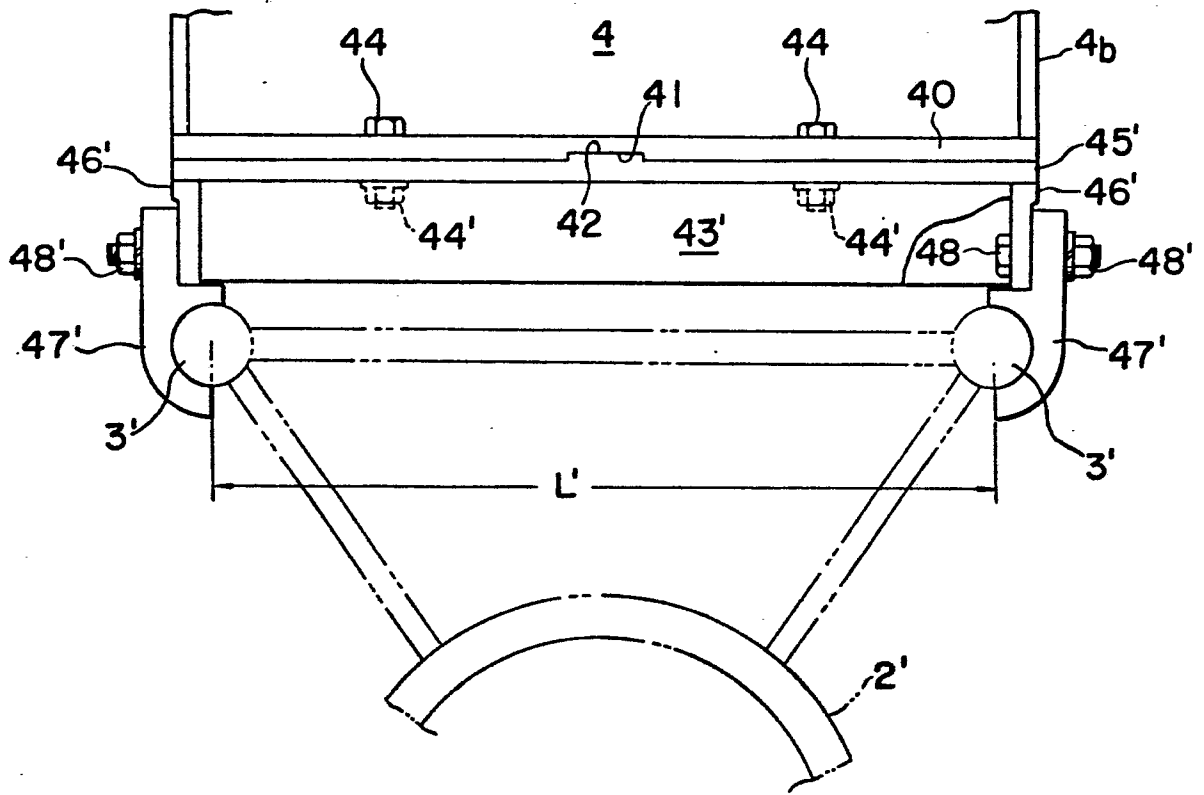
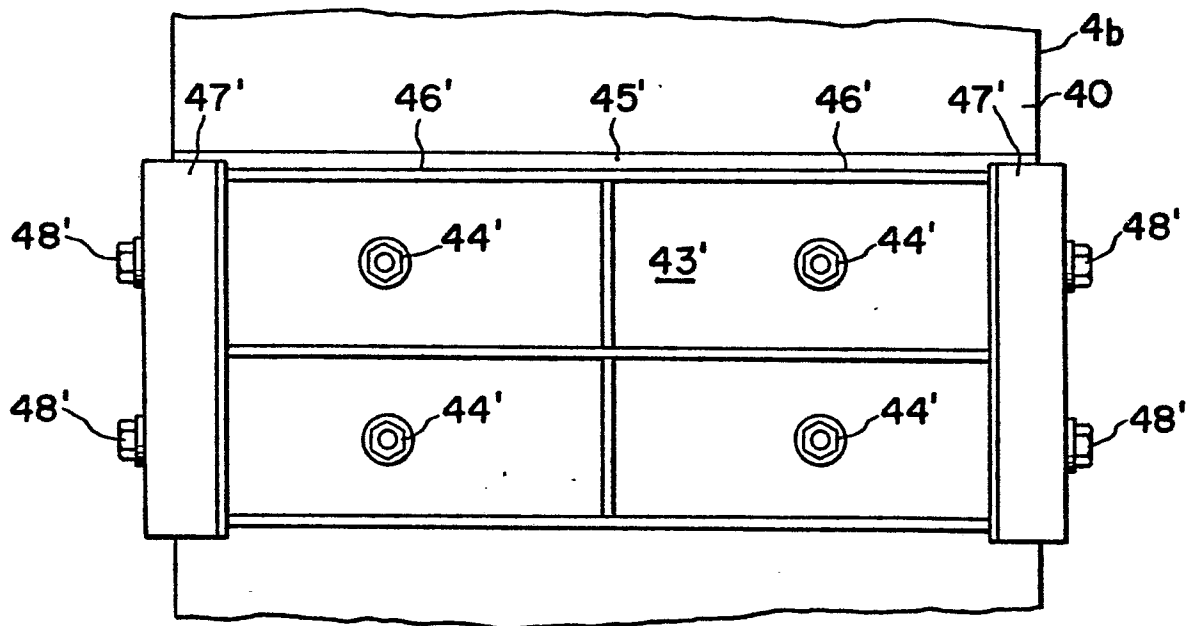


FIG. 10(B)



10/15

0020779

FIG. 11

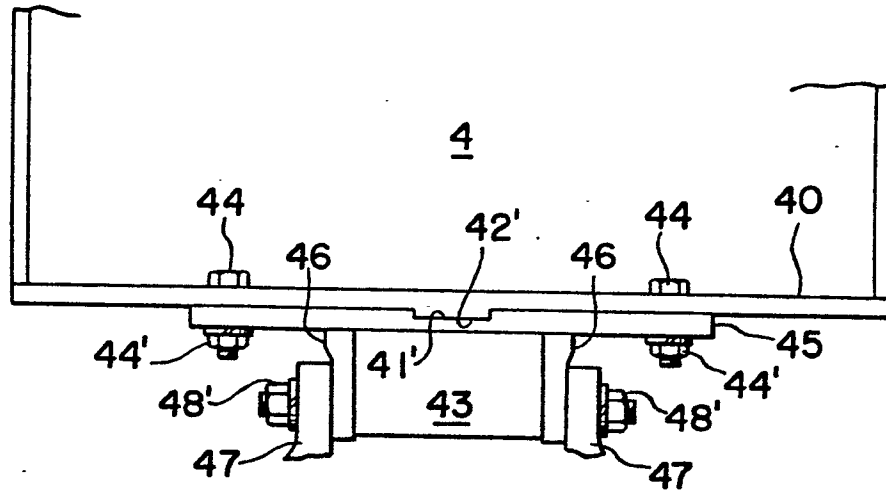
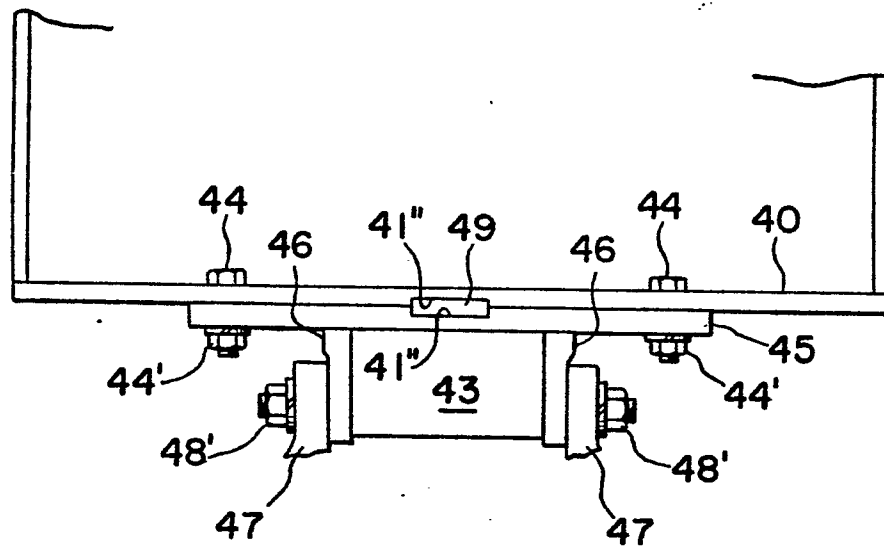


FIG. 12



12/15

FIG. 14(A)

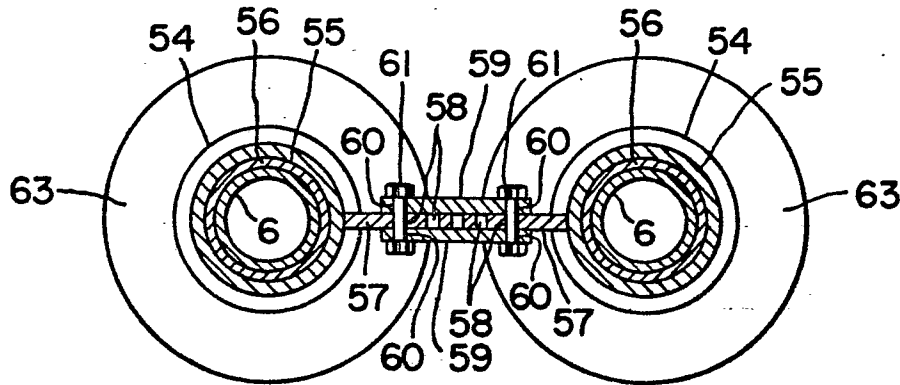


FIG. 14(B)

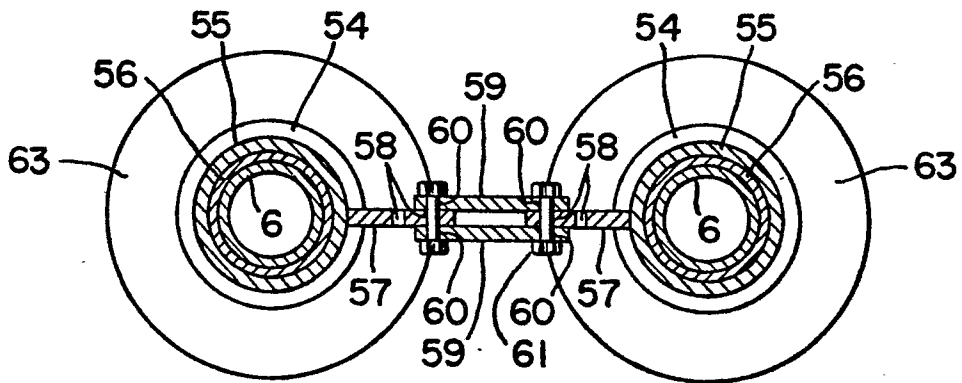


FIG. 15

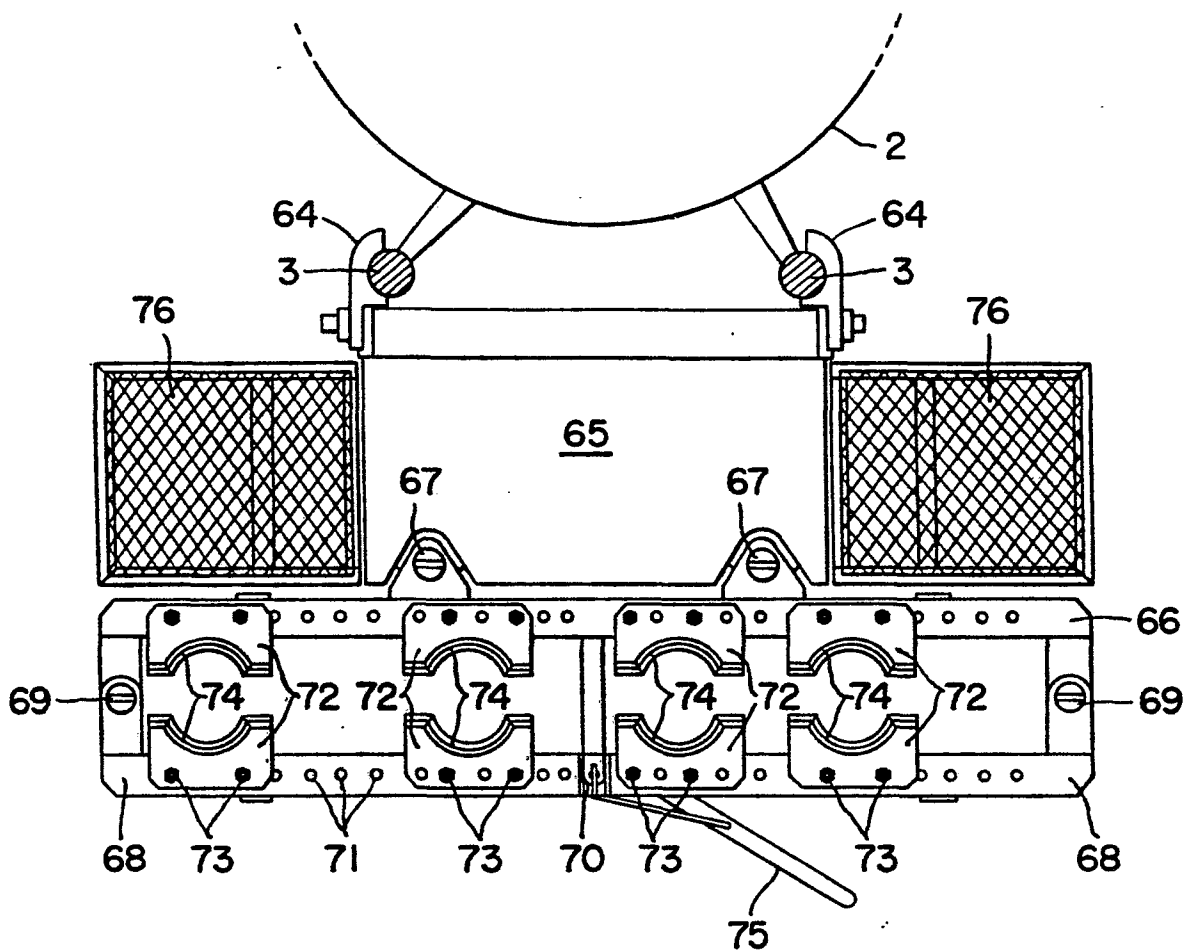


FIG. 16

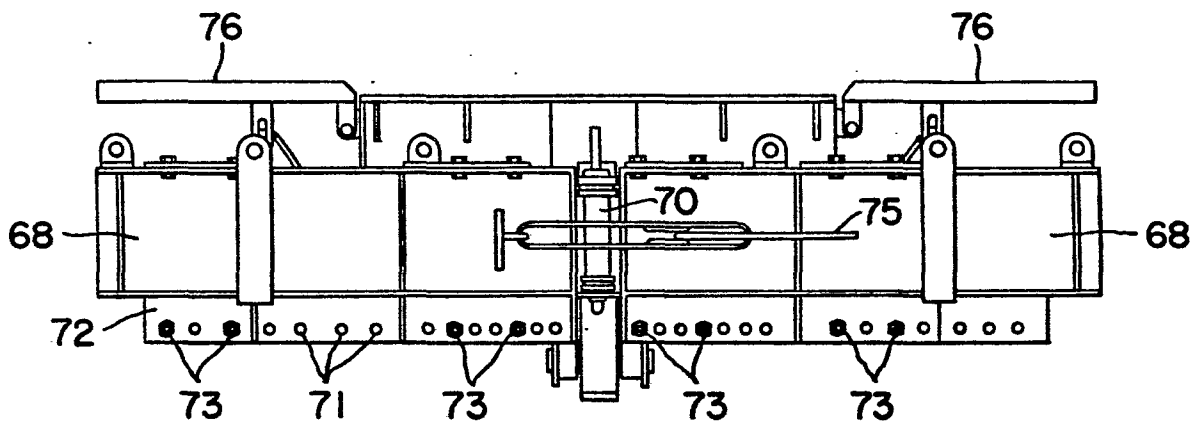


FIG. 17

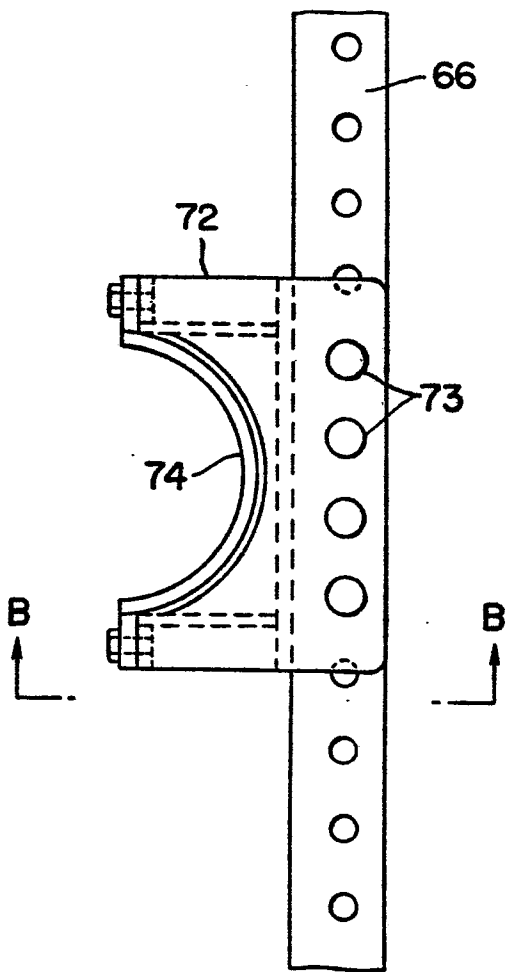
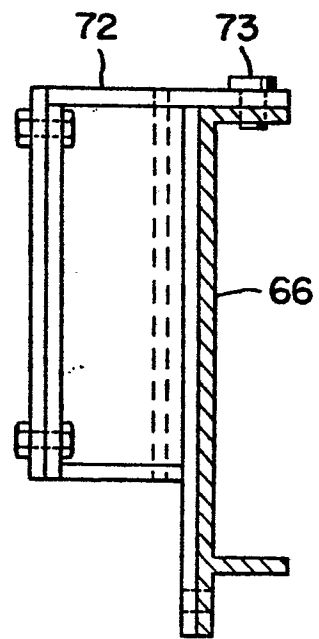


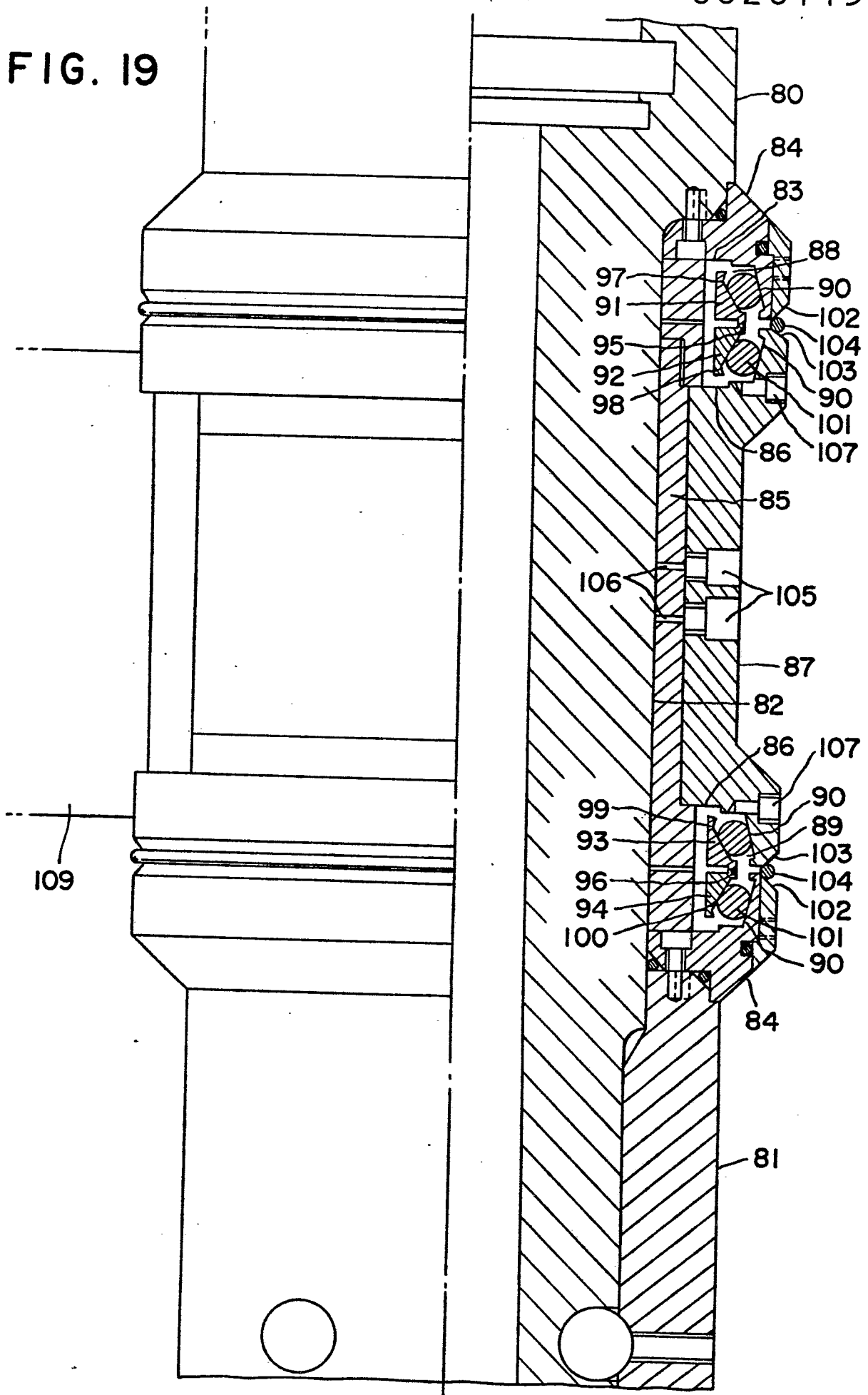
FIG. 18



15/95

0020779

FIG. 19



INTERNATIONAL SEARCH REPORT

International Application No PCT/JP79/00292

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ³				
According to International Patent Classification (IPC) or to both National Classification and IPC	0020779			
E02D 17/13				
II. FIELDS SEARCHED				
Minimum Documentation Searched ⁴				
Classification System	Classification Symbols			
I P C	E02D 17/13, E02D 7/00			
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵				
Jitsuyo Shinan Koho	1930-1979			
Kokai Jitsuyo Shinan Koho	1974-1979			
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴				
Category *	Citation of Document, ¹⁶ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸		
P	JP, A, 54-112509, 1979-9-3 ASADA KIZAI KABUSHIKI KAISHA and tow others	1		
X	JP, A, 51-102310, 1976-9-9 Onoda Cement Co., Ltd.	1		
X	JP, A, 53-111602, 1978-9-29 TAKENAKA KOMUTEN CO., LTD.	4		
<p>* Special categories of cited documents: ¹⁵</p> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"> <p>"A" document defining the general state of the art</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document cited for special reason other than those referred to in the other categories</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> </td> <td style="width: 50%; border: none;"> <p>"P" document published prior to the international filing date but on or after the priority date claimed</p> <p>"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance</p> </td> </tr> </table>			<p>"A" document defining the general state of the art</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document cited for special reason other than those referred to in the other categories</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p>	<p>"P" document published prior to the international filing date but on or after the priority date claimed</p> <p>"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance</p>
<p>"A" document defining the general state of the art</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document cited for special reason other than those referred to in the other categories</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p>	<p>"P" document published prior to the international filing date but on or after the priority date claimed</p> <p>"T" later document published on or after the international filing date or priority date and not in conflict with the application, but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance</p>			
IV. CERTIFICATION				
Date of the Actual Completion of the International Search ³	Date of Mailing of this International Search Report ³			
January 11, 1980 (11.01.80)	January 28, 1980 (28.01.80)			
International Searching Authority ¹	Signature of Authorized Officer ²⁰			
Japanese Patent Office				