

**BELL SYSTEM PRACTICES**  
**Outside Plant Construction**  
**and Maintenance**

**SECTION G94.100.1**  
**Issue 2, October, 1952**  
**AT&T Co Standard**

# HC EARTH BORING MACHINE

<b>Contents</b>	<b>Page</b>
1. General .....	1
2. Safety Precautions .....	1
3. Description .....	2
4. Controls and Gears for Operating the Auger and Plumbing the Rack Shaft .....	4
5. Learning to Operate the Machine .....	7
6. Operation of the Power Leveling Mechanism ....	10
7. Plumbing the Rack Shaft .....	12
8. Normal Boring Procedure .....	12
9. Boring in Rocky Ground .....	14
10. Boring in Wet Ground or Clay .....	14
11. Boring in Frozen Ground .....	15
12. Changing Auger, Auger Blade, Auger Thrust Plate or Auger Point .....	15
13. Inspection, Lubrication and Maintenance .....	17

## 1. GENERAL

- 1.01 This section replaces Sections G94.100.1, Issue 1 and J6.076, Issue 1.
- 1.02 The HC earth boring machine is used to dig holes up to 30 inches in diameter and 8 feet deep and is equipped with an integral derrick for setting poles.
- 1.03 Improper operation of this machine can cause costly damage and delay. Therefore, Parts 4 and 5 of this Practice have been included principally for training inexperienced men to operate the machine properly.

## 2. SAFETY PRECAUTIONS

- 2.01 When traveling to and from the job, the rack lock should be engaged and the machine should be in the carrying position.

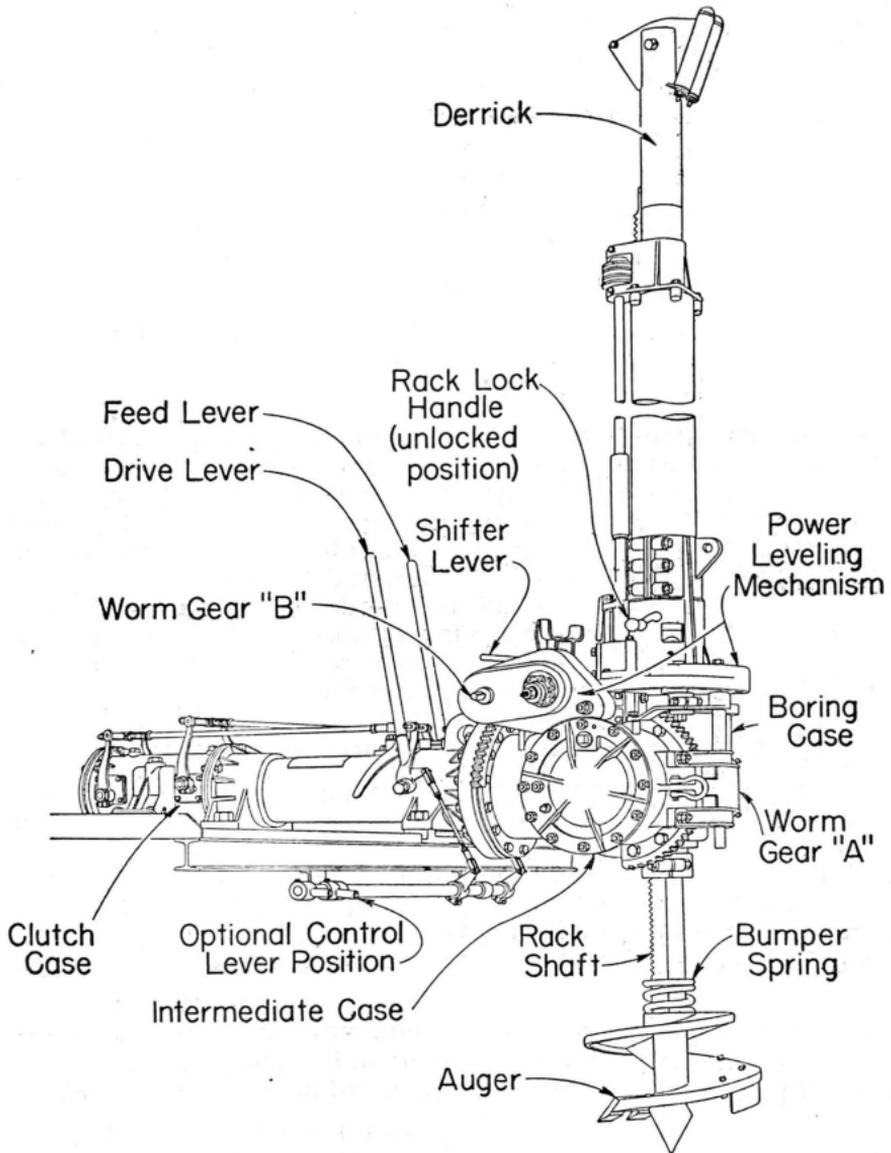
2.02 When moving from one pole location to another on the same job, the machine may be left in the boring position, but the rack lock should be engaged. Make sure that there are no ground obstructions in the path of the auger or overhead obstructions in the path of the derrick.

2.03 On slopes or grades, chock the front wheels of the truck during the hole boring operation.

2.04 Whenever a boring operation is completed, pull the feed and drive control levers back to the brake position making sure that the brake lock engages both levers to hold them in the locked position.

### 3. DESCRIPTION

3.01 The following figure shows an HC earth boring machine in the boring position and identifies the parts of the machine referred to in this practice. Additional parts information, if required, is included in a section of the Motor Vehicle and Construction Apparatus Practices entitled "HC Earth Boring Machine—Maintenance."



3.02 In the preceding figure, the feed and drive control levers are shown in the position for operating the machine from the truck platform. However, the machine may be operated from the ground by moving the control levers to the optional position.

3.03 The boring machine is bolted to the truck platform and is driven by the truck engine through the truck transmission and a power take-off transmission.

3.04 Power driven gears are provided for raising the machine to the boring position, plumbing the rack shaft preparatory to boring a hole and for lowering the machine to the carrying position.

3.05 Power driven gears are provided for telescoping the integral derrick. Description and operation of the derrick are covered in the Section of Practices entitled "Pole Derricks—Earth Boring Machine Type."

#### **4. CONTROLS AND GEARS FOR OPERATING THE AUGER AND PLUMBING THE RACK SHAFT**

4.01 The operation of the auger is controlled by two levers, called the drive lever and the feed lever, which in turn control two interlocked gear trains called the drive gears and the feed gears. The word interlocked is used to emphasize the fact that each gear train is dependent on the other. Each control lever has three operating positions which are the brake position, the neutral position and the clutch engage position. In the following schematic both clutches are shown in the neutral position to clarify the drawing; however, the action portrayed by the schematic is with the assumption that both clutches are engaged and that power is being transmitted from the power take-off to both the drive and feed gear trains.

Power Take-Off Gear  
Assume Speed of 1000 R.P.M.

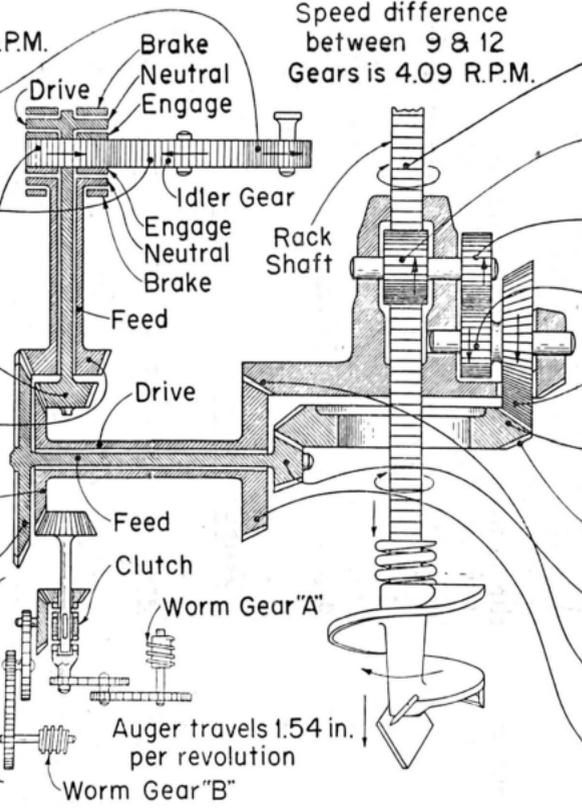
Speed difference  
between 9 & 12  
Gears is 4.09 R.P.M.

1	No. of Teeth	17
	R.P.M.	1000
2	No. of Teeth	44
	R.P.M.	386.36
3	No. of Teeth	35
	R.P.M.	485.71
4	No. of Teeth	11
	R.P.M.	485.71
5	No. of Teeth	13
	R.P.M.	485.71
6	No. of Teeth	26
	R.P.M.	205.42
7	No. of Teeth	32
	R.P.M.	197.26

17	RPM	71.92
	Speed	9.25 $\frac{\text{ft.}}{\text{min.}}$
16	No. of Teeth	14
	R.P.M.	10.11
15	No. of Teeth	15
	R.P.M.	10.11
14	No. of Teeth	15
	R.P.M.	10.11
13	No. of Teeth	15
	R.P.M.	10.11
12	No. of Teeth	37
	R.P.M.	67.83
11	No. of Teeth	32
	R.P.M.	67.83
10	No. of Teeth	11
	R.P.M.	197.26
9	No. of Teeth	40
	R.P.M.	71.92
8	No. of Teeth	14
	R.P.M.	205.42

Power Leveling  
Gears

Auger travels 1.54 in.  
per revolution



Schematic of H.C. Earth Boring Machine Gears

4.02 The schematic is to a large extent self-explanatory; however, in order to enable the reader to quickly obtain an understanding of the action portrayed, the following notes are provided.

(1) Feed gears No. 11 and No. 12 are the top and bottom surfaces of a double bevel gear.

(2) When drive gear No. 9 turns, it carries with it that portion of the boring case that supports feed gears Nos. 13, 14, 15, 16 and the rack shaft. Therefore, even if feed gear No. 12 is stationary, feed gear No. 13 will turn if drive gear No. 9 is turning. However, on the schematic feed gear No. 12 is turning in the same direction as drive gear No. 9 but not as fast. The relative motion between these two gears is 71.92-67.83 or 4.09 rpm.

(3) The following tabulation indicates the action that will take place for the different combinations of control lever operating positions. Variations of these actions will be obtained if the control levers are not pushed or pulled hard enough to prevent slipping the clutch or brake. However, for the purpose of the following tabulation, it is assumed that in either the brake or clutch engage position there is no slipping; and, that in the neutral position the gear trains are free to turn or remain stationary independent of the power take-off driving gears.

<u>Control Lever Position</u>		<u>Auger Action</u>		<u>Remarks</u>
<u>Feed</u>	<u>Drive</u>	<u>Up-Down</u>	<u>Rotation</u>	<u>Assume P.T.O. Gear Is Turning 1000 rpm</u>
Brake	Clutch	Down	71.9 rpm	Auger moves down 162'/min.
Neutral	Clutch	Down to stationary	71.9 rpm	Down speed of auger depends on resistance encountered and can vary from 162'/min. to 0'/min.
Clutch	Clutch	Down	71.9 rpm	Auger moves down 9.25'/min.
Clutch	Neutral	Up to stationary	0 to 67.8 rpm	Auger must either turn or move up.
Clutch	Brake	Up	0	Auger moves up 153'/min.

4.03 The operation of the power leveling gears is controlled by the shift lever on top of the intermediate case, and the drive control lever. The shift lever controls a clutch which is used to transmit power from the drive gear train to either one of two worm gears labeled "A" and "B" and shown in the lower left corner of the figure following Paragraph 4.01. When the shift lever is lifted up, the clutch engages worm gear "B"; when the shift lever is pushed down, the clutch engages worm gear "A"; and when the shift lever is at the midpoint, half-way between its up and down extremes, the clutch does not engage either one of the worm gears. Worm gear "A" rotates the boring case and rack shaft with respect to the intermediate case. Worm gear "B" rotates the intermediate case, boring case and rack shaft with respect to the clutch case. In order to transmit power to these gears, it is necessary to operate the drive control lever to the clutch engage position. Since the drive lever affects the action of the auger, the rack lock should be engaged and the feed control lever should be in the neutral position to keep the auger from moving up or down during operation of the power leveling gears. However, the auger will rotate during operation of the power leveling gears.

## 5. LEARNING TO OPERATE THE MACHINE

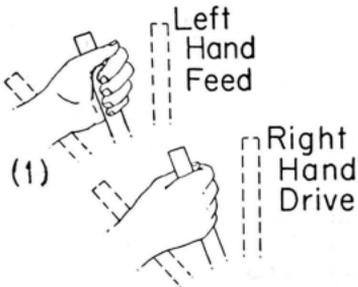
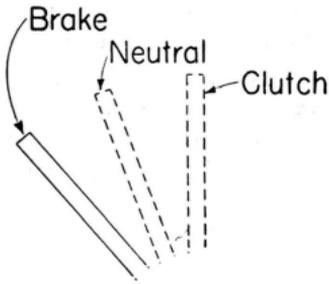
5.01 After becoming familiar with Part 4 of this practice, the beginner should be given an opportunity to operate the machine, not with the intention of digging pole holes, but for the purpose of becoming accustomed to the controls and the associated action of the auger.

5.02 An experienced truck driver should operate the truck engine and power take-off controls.

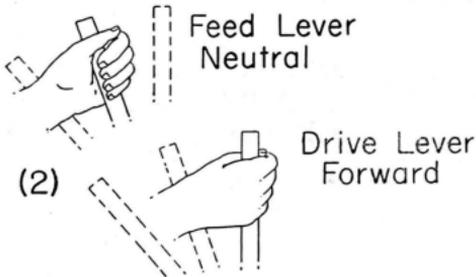
5.03 Select a location where there will be no objection to the digging of several holes and have an experienced operator place the boring machine in the digging position and release the rack lock. Avoid digging in refuse dumps because the auger may become entangled in buried wire or debris.

5.04 Direct the truck driver to put the power take-off in the forward gear and the transmission in the lowest forward speed and operate the truck engine at a slow speed. Allow the beginner to operate the boring machine for the purpose of becoming familiar with the control levers.

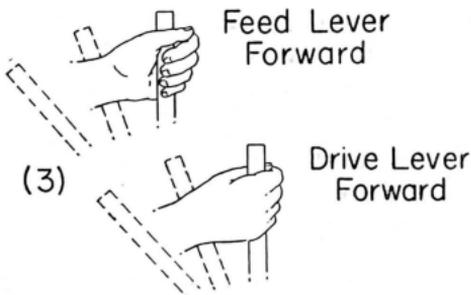
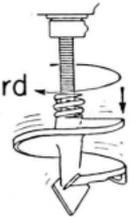
5.05 The following figure shows the auger action that will take place for the different combinations of control lever positions. The sequence of operations shown is a good one to follow when operating the machine for the first time.



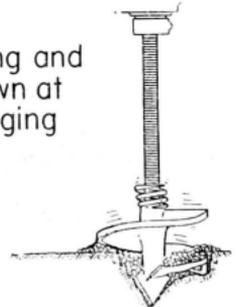
Auger Stationary

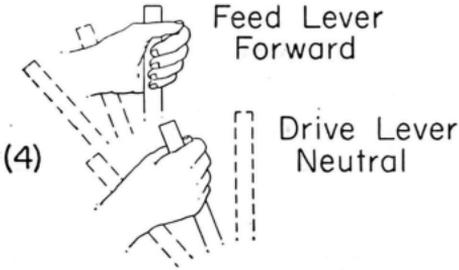


Auger turning and moving down. Will stop downward motion if it encounters sufficient ground resistance.

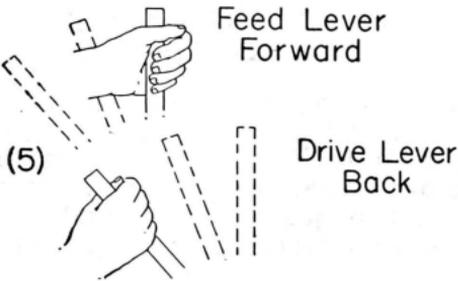


Auger turning and moving down at normal digging speed.





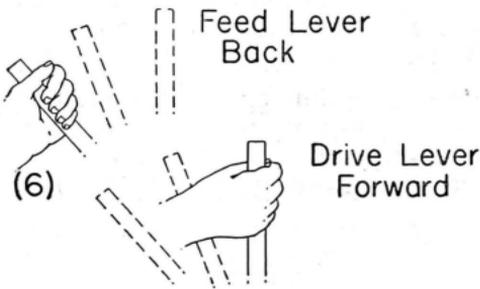
Auger must either turn or come up.



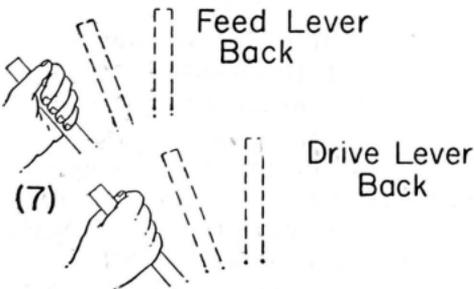
Auger cannot turn and must come up.



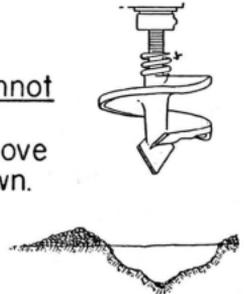
Repeat (3) to spin dirt off the auger.



Auger must turn and must move down - fast



Auger cannot turn and cannot move up or down.



5.06 After running through this sequence of operations the operator may try variations of the control lever positions. As he becomes accustomed to the machine and feels he would like to operate at faster speeds, he should request the truck driver to place the truck transmission in the next higher speed gear.

5.07 In general the control levers should be operated the full extent of their travel in either direction or held in the neutral position. This will minimize clutch and brake slipping.

5.08 The operator should keep in mind that if he becomes confused, the best thing he can do is release both operating control levers. This will permit both levers to return to the neutral position and will not damage the machine.

5.09 With additional practice, for normal digging the operator will soon be able to control the machine with the truck transmission in third gear and a truck engine speed of 1500 rpm (about 25 m.p.h. in high gear).

5.10 Smooth, efficient boring machine operation requires good coordination between the truck driver and the boring machine operator. With a little experience the truck driver will soon learn from the movements and signals of the boring machine operator, which auger action is taking place and which truck engine speed is most suitable for the particular operation.

5.11 The boring machine operator should avoid "whip sawing" the control levers; i.e., moving both levers from one extreme to the other at the same time. The smoothest and most efficient operation is obtained by moving the control levers one at a time and pausing at the neutral position rather than moving quickly from the clutch position to the brake position.

## **6. OPERATION OF THE POWER LEVELING MECHANISM**

6.01 The following figure shows the dial which is provided on top of the intermediate case to indicate the shift lever position and the power take-off gear required to move the rack shaft in any one of four directions.



6.02 The letters on the above figure have the following meanings:

- D—move shift lever to **D**own position.
- L—place power take-off in **L**ow gear.
- R—place power take-off in **R**everse gear.
- U—move shift lever to **U**p position.

The arrows indicate the direction that the derrick and top end of the rack shaft will move in response to the shift lever positions and power take-off gears indicated by the letters at the heads of the arrow.

6.03 During power leveling operations direct the truck driver to operate the truck engine at idling speed.

6.04 When operating the shift lever, make sure it is moved the full extent of its travel in either the up or down direction to engage its associated clutch properly. When difficulty is experienced in moving the shift lever, apply momentary pressure to the drive control lever in the clutch engage direction, at the same time applying pressure to the shift lever to move it in the desired direction.

6.05 After completion of a power leveling operation, move the shift lever to a position half-way between its up and down positions. This is its neutral position.

6.06 When lowering the derrick and boring case from the boring position to the carrying position, make sure the derrick tube lines up with its support at the front end of the truck platform.

## 7. PLUMBING THE RACK SHAFT

- 7.01 Raise the derrick and boring case from the carrying to the boring position using the power leveling mechanism described in Part 6.
- 7.02 Position the truck so that auger is over the proposed hole location.
- 7.03 Plumb the rack shaft either by using the power leveling mechanism described in Part 6 or by manually operating the leveling worms using the wrench provided for this purpose.
- 7.04 If desired, a hole may be bored at an angle such as may be required for placing an anchor or push brace. In which case, it is necessary to line the rack shaft up with the desired direction of the hole in the same manner as described in Paragraph 7.03.

## 8. NORMAL BORING PROCEDURE

- 8.01 Having maneuvered the truck into position so that the boring machine is over the proposed hole location, and having plumbed the rack shaft as explained in Part 7, direct the truck driver to place the truck transmission in third speed forward gear and to operate the truck engine at idling speed.
- 8.02 Release the lock holding the drive and feed control levers in the brake position. Move the rack lock handle from the locked position to the unlocked position. If the rack lock handle is difficult to move, apply momentary pressure, in the clutch engage direction, to the feed lever, simultaneously pulling on the rack lock handle to move it to the unlocked position.
- 8.03 Direct the truck driver to operate the truck engine at the customary digging speed. Some operators may desire a faster truck engine speed than others and this is a matter of coordination between the truck driver and the boring machine operator which can only be arrived at by experience (see Part 5 of this Practice).
- 8.04 The following procedure is recommended for digging holes in soils not containing large rocks or high percentages of clay.

<u>Action Required by Boring Machine Operator</u>	<u>Resulting Action of Auger</u>
(1) Push drive lever (right-hand) to clutch engage position.	(1) Auger will turn and will descend until stopped by the ground.

- |   |   |
|---|---|
| <p>(2) After auger reaches the ground, push feed lever (left-hand) to clutch engage position.</p> <p>(3) After auger loads up with dirt up to the bumper spring, pull drive lever back to neutral position.</p> <p>(4) Pull drive lever to brake position as much as is required to lift the auger.</p> <p>(5) Just before the bumper spring reaches the bottom of the boring case, push drive lever to clutch engage position.</p> <p>(6) After dirt is spun off of auger, pull feed lever to neutral position.</p> <p>(7) If auger does not descend fast enough pull feed lever to brake position momentarily, and return it to the neutral position.</p> | <p>(2) Auger will continue to turn and will descend slowly. This is the normal digging condition. Auger will load up with dirt.</p> <p>(3) Auger must either continue to turn or rise out of the hole.</p> <p>(4) Auger will slow down or stop turning completely (if drive brake is held on) and rise out of hole.</p> <p>(5) Same as (3) except intent is to spin dirt off of auger rather than to dig.</p> <p>(6) Auger will continue to turn and will probably descend into hole.</p> <p>(7) Auger will continue to turn and will descend fast.</p> |
|---|---|

Continue the above cycle of steps (2) to (7) until the hole is dug to the desired depth.

8.05 After the hole is dug, raise the auger until the bumper spring is a few inches below the boring case. Move the rack lock handle to the locked position. Pull the drive and feed levers back to the brake position to engage the control lever lock. Direct the truck driver to put the power take-off in neutral gear.

8.06 Move the truck forward about 1 to 2 feet before attempting to set a pole in the hole just dug. Consult the section of Practices entitled "Pole Derricks—Earth Boring Machine Type" for information concerning use of the derrick.

## 9. BORING IN ROCKY GROUND

9.01 The procedure for boring holes in rocky ground is the same as is explained in Part 8 except that the truck transmission should be in low or second speed forward gear and the truck engine operated at a slower speed than that which is normally used when the digging is easy.

9.02 When an individual rock is encountered in a hole, its location can usually be determined by observing which way the auger is pushed when it strikes the rock.

9.03 If a large individual rock is encountered in the center of the hole, it may be necessary to remove the auger and then remove the rock with a digging spoon.

9.04 If a rock is encountered in the side of the hole, it may be possible to tilt the rack shaft, using the controls explained in Part 7 and slide past the rock. After the auger has passed the rock, it is sometimes possible to straighten the rack shaft again and pull the rock loose by raising the auger; however, it is necessary to proceed cautiously so as not to overload the boring machine or the truck springs.

9.05 Sometimes it may be possible to bore past the rock and make the hole deeper than is necessary to set the pole, and then to push the rock out of the side of the hole and into the bottom of the hole where it can remain and not interfere with setting the pole.

9.06 A sharp auger blade and point will make digging in rocky ground easier.

9.07 If the auger should become caught under a rock, request the truck driver to place the power take-off in reverse gear, then move the feed and drive control levers to the clutch engage position. This will turn the auger backwards and raise it slowly at the same time, and should free the auger from the obstruction in the hole.

## 10. BORING IN WET GROUND OR CLAY

10.01 When digging in heavy clay or wet ground do not load the auger with soil above the bottom of the bumper spring.

10.02 When ready to raise the loaded auger out of the hole, proceed cautiously since it is possible to encounter considerable suction in wet or clay soil. The best procedure is to move the drive lever to neutral and hold the feed clutch engaged; then the auger must either turn or move upward. Then momentarily pull the drive lever to the brake position to start the auger moving up. Do not hold the drive lever in the brake position, but return it to the neutral position to allow the

auger to start turning again and thereby help break the suction. Several applications of brake and release to the drive gears may be necessary to break the suction before the auger can be raised out of the hole.

## **11. BORING IN FROZEN GROUND**

11.01 Boring holes in frozen ground is similar to boring in rocky ground. The truck transmission should be placed in low or second gear and the truck engine operated at a slower speed than is ordinarily used for boring in soft ground. During the boring operation make sure the feed and drive control levers are pushed far enough to prevent the associated clutches from slipping, in order to make sure the auger continues to move downward and does not slide over top of the frozen ground.

11.02 When boring into frozen ground it is essential that the auger be equipped with a sharp blade and point.

## **12. CHANGING AUGER, AUGER BLADE, AUGER THRUST PLATE OR AUGER POINT**

12.01 The diameter of the hole which the machine bores is about 1 inch larger than the diameter of the auger used. The augers which are available for use with the HC Earth Boring Machine are 9, 12, 16, 20, 24 and 30 inches in diameter.

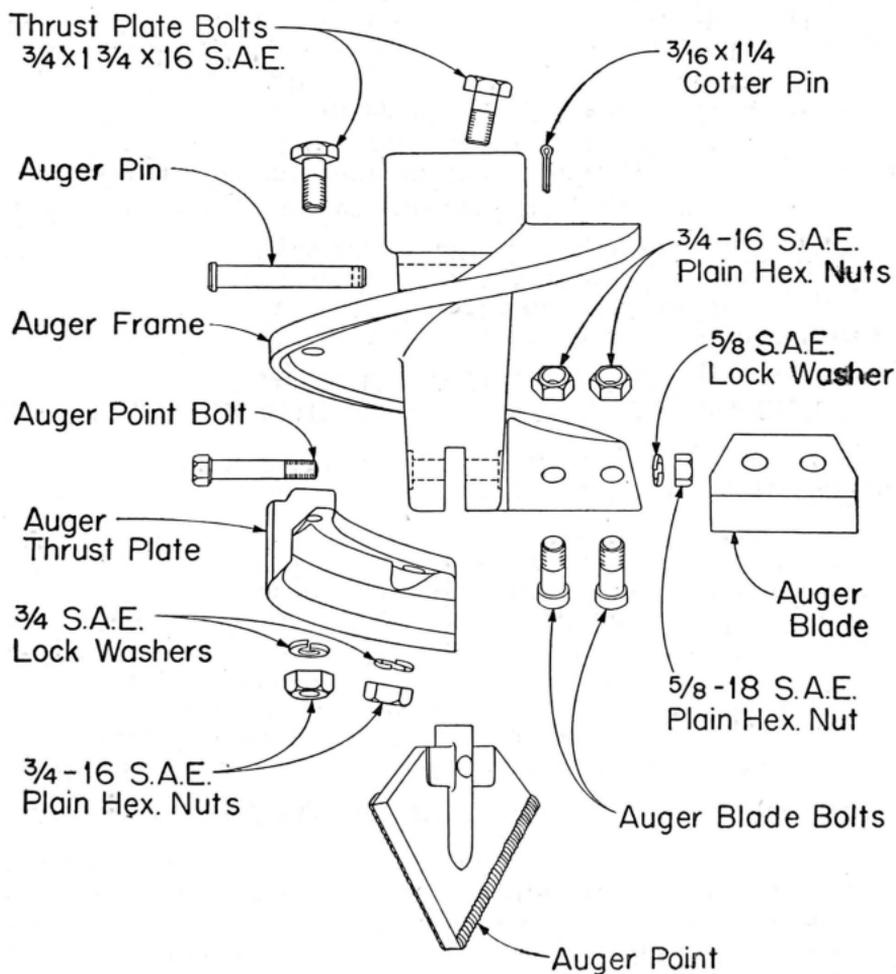
12.02 To change augers proceed as follows:

- (a) With the machine in the boring position, release the rack lock and lower the auger to the ground.
- (b) Remove the cotter pin in the auger pin and remove the auger pin.
- (c) Raise the auger at a very slow speed (transmission in low forward gear) until the bottom of the boring case pushes the bumper spring and auger off of the auger rack shaft.
- (d) Lay the old auger aside and place the new auger on the ground under the auger rack shaft with the auger point down.
- (e) Set the bumper spring on top of the new auger over the hole for the auger rack shaft.
- (f) Lower the auger rack shaft at a very slow speed until it passes through the bumper spring, enters the hole in the auger and the auger pin hole in the auger lines up with the hole in the end of the auger rack shaft.
- (g) Replace the auger pin and secure it in place with a  $3/16'' \times 1-1/4''$  cotter pin.

12.03 The auger thrust plate should be replaced before it becomes worn down to the point that it permits excessive wear of the auger frame.

12.04 The auger blade should either be turned over or replaced whenever its bottom cutting edge becomes worn. The auger point should be replaced whenever its cutting edges become worn. It is particularly important to use a sharp auger blade and auger point when boring in frozen ground, "hardpan," shale or sandstone.

12.05 The following figure shows in detail the various parts of the auger assembly. The nuts and bolts should be drawn up tight; however, the auger point will still fit loosely even though the auger point nut and bolt are tightened securely.

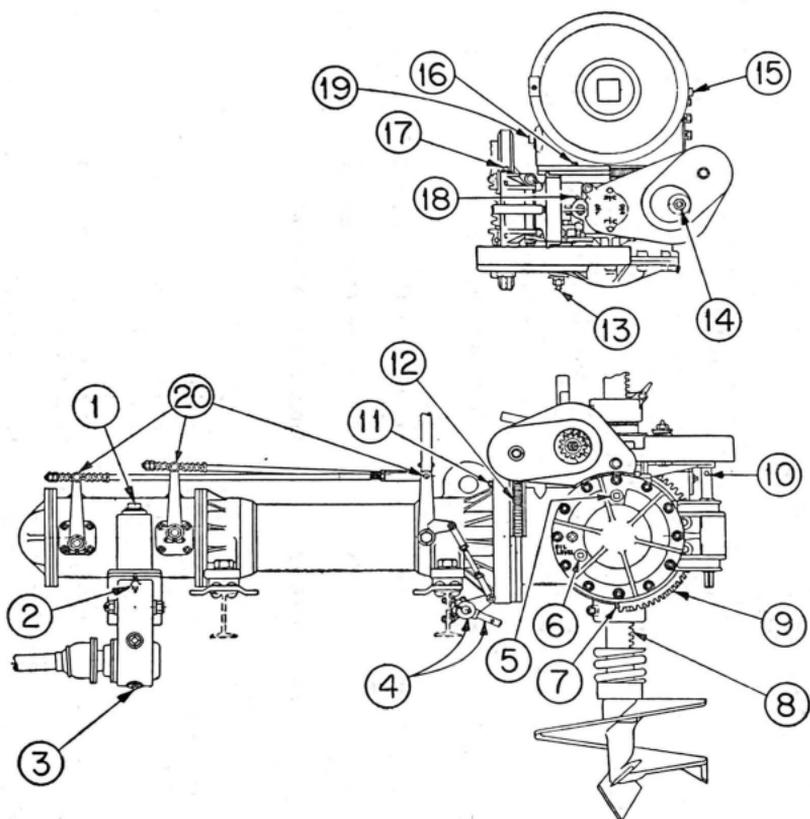


### 13. INSPECTION, LUBRICATION AND MAINTENANCE

13.01 Because of the heavy duty service which these machines perform, it is important that they receive proper inspection, lubrication and maintenance attention in order to avoid costly damage and delay.

13.02 The machine should be inspected daily and any bolts or fastenings which are found loose should be tightened.

13.03 The machine should be lubricated at the locations shown in the following figure and in accordance with the instructions given on the lubrication chart which follows this figure.



## LUBRICATION

<u>Ref. No.</u>	<u>Location</u>	<u>Frequency</u>	<u>Recommended Action</u>	<u>Type</u>	<u>Recommended Lubricant</u>	
					<u>Grade</u>	
					<u>Above 32° F.</u>	<u>Below 32° F.</u>
8	Rack Shaft	Daily or Oftener. See Par. 13.04	Clean and lubricate with wiping cloth or wire brush on teeth and sides	"Hi-Lo" Lubricant	#428	#428
1, 2	Clutch Case	Daily	If below level add lubri- cant at (1) to bring up to level (2)	Engine Oil	SAE 10	SAE 10
5, 6	Intermediate Case	Daily	Check level (6) and add lubricant if necessary (5)	General Purpose Grease	No. 3	No. 1
15, 19	Boring Case	Daily	Check level (15 and 19) and add lubricant if neces- sary	General Purpose Grease	No. 3	No. 1
9, 12	Leveling Worm Wheels	Weekly or Oftener. See Par. 13.05	Clean and lubricate	"Hi-Lo" Lubricant	#428	#428
10, 17	Leveling Worm Shafts	Weekly	Grease gun (10) and (17)	General Purpose Grease	No. 3	No. 1
11, 16	Leveling Segments	Weekly	Grease gun (11) and (16)	General Purpose Grease	No. 3	No. 1
13, 14, 18	Power Leveling Mechanism	Weekly	Grease gun (13) (14) (18)	General Purpose Grease	No. 3	No. 1
4	Control Levers	Weekly	Grease gun (4) (2 fittings)	General Purpose Grease	No. 3	No. 1
20	Control Levers	Weekly	All joints	Engine Oil	SAE 10	SAE 10
1, 2, 3	Clutch Case	Spring and Fall. See Par. 13.06	Drain (3) and refill (1) to Level (2)	Engine Oil	SAE 10	SAE 10
5, 7	Intermediate Case	Spring and Fall. See Par. 13.06	Drain (7) and refill (5) to Level (6)	General Purpose Grease	No. 3	No. 1
15, 19	Boring Case	Spring and Fall. See Par. 13.06 and 13.07	Drain and refill.	General Purpose Grease	No. 3	No. 1

13.04 The teeth and sides of the auger rack bar should be kept clean and well lubricated. When digging in wet ground or heavy clay it may be necessary to clean and grease the auger rack shaft after every hole. A wiping cloth should be used to remove wet soil or mud and a wire brush should be used to remove heavy or sticky deposits such as clay.

13.05 Never operate the leveling worms unless the worms and worm wheels are clean and well lubricated. If during operation of the leveling worms, there is any indication of lack of lubrication or dirt on the teeth, stop the machine and clean and lubricate the worms and worm wheels. Change the position of the boring machine as required, to clean and lubricate all the teeth of the leveling worm wheels.

13.06 The clutch case, intermediate case and boring case should be drained while the machine is warm to insure removal of the maximum amount of old oil and grease.

13.07 To drain the boring case without removing the auger rack bar, raise the machine to the boring position, then place the boring case horizontal (see Part 6) with the filler plug (15) on bottom. Remove filler plug (15) to drain out the old grease. After the boring case is drained, operate worm gear "B" to raise the boring case to the vertical position. Fill boring case with lubricant up to level plug (15 or 19).