

**Instruction 51-1161
12-12-05**

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Because every industry has a leader

Installation Instructions for S&S Oil Pump for Twin Cam 88® Engines

DISCLAIMER:

S&S parts are designed for high performance, off road, racing applications and are intended for the very experienced rider only. The installation of S&S parts may void or adversely effect your factory warranty. In addition such installation and use may violate certain federal, state, and local laws, rules and ordinances as well as other laws when used on motor vehicles used on public highways, especially in states where pollution laws may apply. Always check federal, state, and local laws before modifying your motorcycle. It is the sole and exclusive responsibility of the user to determine the suitability of the product for his or her use, and the user shall assume all legal, personal injury risk and liability and all other obligations, duties, and risks associated therewith.

The words Harley®, Harley-Davidson®, H-D®, Sportster®, Evolution®, and all H-D part numbers and model designations are used in reference only. S&S Cycle is not associated with Harley-Davidson, Inc.

SAFE INSTALLATION AND OPERATION RULES:

Before installing your new S&S part it is your responsibility to read and follow the installation and maintenance procedures in these instructions and follow the basic rules below for your personal safety.

- Gasoline is extremely flammable and explosive under certain conditions and toxic when breathed. Do not smoke. Perform installation in a well ventilated area away from open flames or sparks.
- If motorcycle has been running, wait until engine and exhaust pipes have cooled down to avoid getting burned before performing any installation steps.
- Before performing any installation steps disconnect battery to eliminate potential sparks and inadvertent engagement of starter while working on electrical components.
- Read instructions thoroughly and carefully so all procedures are completely understood before performing any installation steps. Contact S&S with any questions you may have if any steps are unclear or any abnormalities occur during installation or operation of motorcycle with a S&S part on it.
- Consult an appropriate service manual for your motorcycle for correct disassembly and reassembly procedures for any parts that need to be removed to facilitate installation.
- Use good judgement when performing installation and operating motorcycle. Good judgement begins with a clear head. Don't let alcohol, drugs or fatigue impair your judgement. Start installation when you are fresh.
- Be sure all federal, state and local laws are obeyed with the installation.
- For optimum performance and safety and to minimize potential damage to carb or other components, use all mounting hardware that is provided and follow all installation instructions.
- Motorcycle exhaust fumes are toxic and poisonous and must not be breathed. Run motorcycle in a well ventilated area where fumes can dissipate.

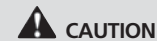
IMPORTANT NOTICE:

Statements in this instruction sheet preceded by the following words are of special significance.



WARNING

Means there is the possibility of injury to yourself or others.



CAUTION

Means there is the possibility of damage to the part or motorcycle.

NOTE

Other information of particular importance has been placed in italic type.

S&S recommends you take special notice of these items.

WARRANTY:

All S&S parts are guaranteed to the original purchaser to be free of manufacturing defects in materials and workmanship for a period of twelve (12) months from the date of purchase. Merchandise that fails to conform to these conditions will be repaired or replaced at S&S's option if the parts are returned to us by the purchaser within the 12 month warranty period or within 10 days thereafter.

In the event warranty service is required, the original purchaser must call or write S&S immediately with the problem. Some problems can be rectified by a telephone call and need no further course of action.

A part that is suspect of being defective must not be replaced by a Dealer without prior authorization from S&S. If it is deemed necessary for S&S to make an evaluation to determine whether the part was defective, a return authorization number must be obtained from S&S. The parts must be packaged properly so as to not cause further damage and be returned prepaid to S&S with a copy of the original invoice of purchase and a detailed letter outlining the nature of the problem, how the part was used and the circumstances at the time of failure. If after an evaluation has been made by S&S and the part was found to be defective, repair, replacement or refund will be granted.

ADDITIONAL WARRANTY PROVISIONS:

- (1) S&S shall have no obligation in the event an S&S part is modified by any other person or organization.
- (2) S&S shall have no obligation if an S&S part becomes defective in whole or in part as a result of improper installation, improper maintenance, improper use, abnormal operation, or any other misuse or mistreatment of the S&S part.
- (3) S&S shall not be liable for any consequential or incidental damages resulting from the failure of an S&S part, the breach of any warranties, the failure to deliver, delay in delivery, delivery in non-conforming condition, or for any other breach of contract or duty between S&S and a customer.
- (4) S&S parts are designed exclusively for use in Harley-Davidson and other American v-twin motorcycles. S&S shall have no warranty or liability obligation if an S&S part is used in any other application.

CAUTION

Be sure that you disconnect the negative battery cable before doing any work on your motorcycle. This will prevent it from accidentally starting during the installation.

NOTE: You will need to remove the pushrods and lifters and any of the oil pump components in your cases before starting the installation procedure.

The first step is to inspect the existing needle bearings and ensure they look and feel OK. They should roll freely and feel smooth with no excessive play. Make sure that you clean the S&S® oil pump parts and crankcase gasket surface before starting.

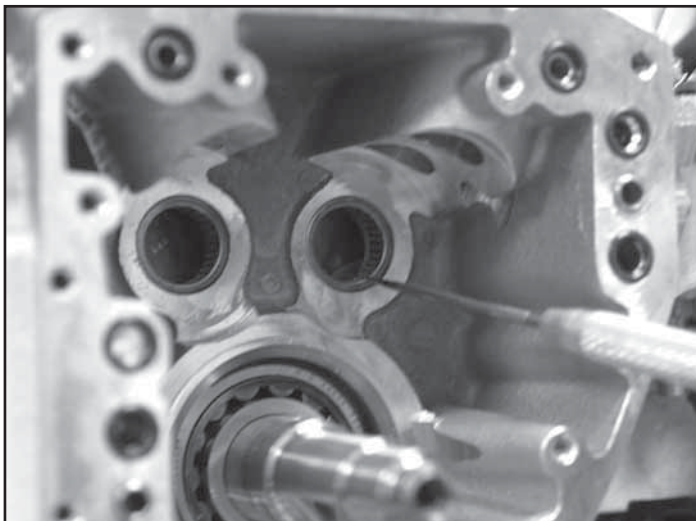


Photo 1

Check the cam lobe to case clearance—especially in stock or H-D® cases—to make sure there will be no interference. S&S recommends a minimum of .060" clearance between the lobe and the case. Be advised that installing a significantly larger cam than stock may also result in a clearance issue between the rocker arm and rocker box—be sure to check this area before starting the motorcycle. Refer to **charts 1 and 2** for more fitment information.

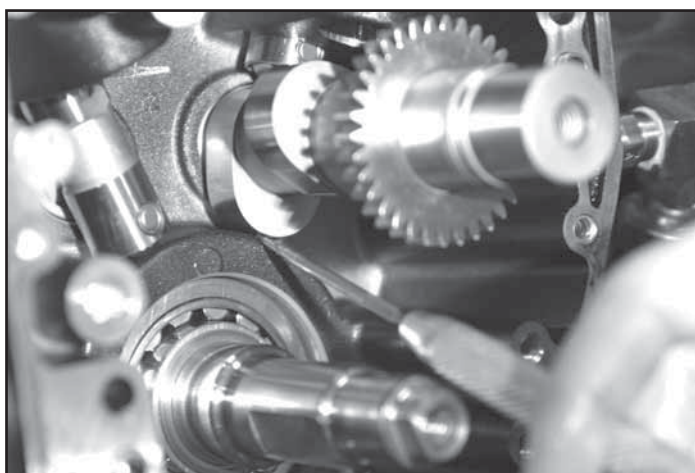


Photo 2

S&S® Gear Drive Camshaft For Use With Twin Cam Style S&S Oil Pump Specification Chart

Cam Name	Valve Timing Open / Close		Valve Duration		Valve Lift	Centerline		Lift @ TDC	
	Intake	Exhaust	Intake	Exhaust		Intake	Exhaust	Intake	Exhaust
510GP	20° / 38°	52° / 20°	238°	252°	.510"	99°	106°	.187"	.179"
570GP	20° / 40°	55° / 20°	240°	255°	.570"	100°	107.5°	.187"	.179"
585GP	20° / 45°	60° / 20°	245°	260°	.585"	102.5°	110°	.186"	.179"
625GP	20° / 55°	60° / 20°	255°	260°	.625"	107.5°	110°	.189"	.184"
640GP	25° / 60°	65° / 25°	265°	270°	.640"	107.5°	110°	.228"	.214"
675GP	25° / 64°	70° / 25°	269°	275°	.675"	109.5°	112.5°	.235"	.205"

Chart 1

Valve to Piston Clearance Chart Stock H-D® Pistons*						
Head Style	Cam					
	510G	570G	585G	625G	640G	675G
Stock	OK	OK	OK	OK	1	1
S&S 79cc	OK	OK	OK	1	1	1
S&S 89cc	2	2	2	2	2	2

Chart 2

*Using unmodified heads with .045" head gaskets.

OK No Clearancing needed.

1 Valve to piston clearances must be checked.

2 Valve pockets in pistons must be modified.

Next, install an O-ring and mount the flywheel cavity return fitting on the S&S oil pump body using the included 8-32 x $\frac{3}{8}$ " socket head cap screws. Be sure to use blue 243 Loctite on the threads and torque to 32 in/lbs.

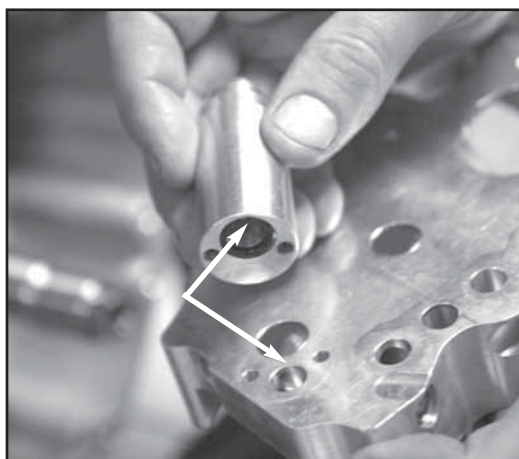


Photo 3

On either H-D® or S&S® cases, verify that locating dowels have not been pushed in all the way. If they have, you will need to thread an appropriate sized screw into it and pull the dowel out to measure .100" - .125". Once the dowel is at the proper depth, thread the S&S thread adapter into it. Note that the thread adapter needs blue 243 Loctite and you **MUST NOT** use a lot of pressure when installing. Just a bit more than hand tight is all that is required.

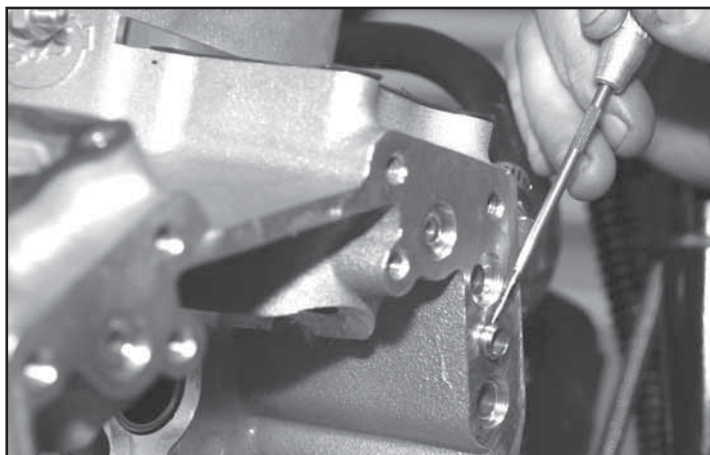


Photo 4

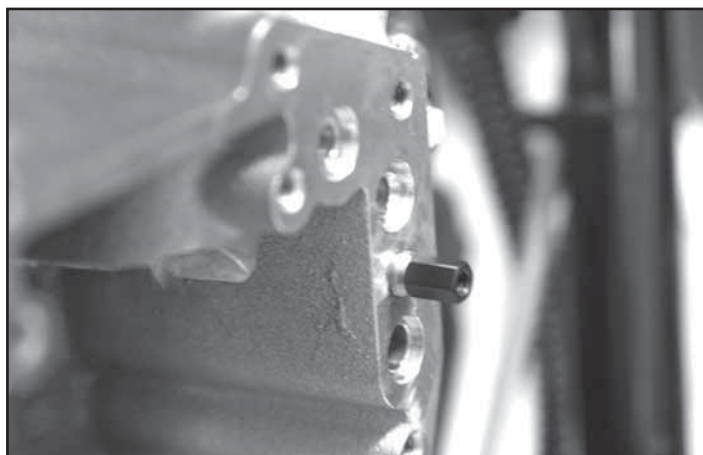


Photo 5

Unpack the S&S reed valve and spring. Install the reed valve over the pinion shaft ensuring that the O-ring is seated fully in the case — there is no specific orientation to worry about. Next, simply slide the spring into the machined groove on the reed valve and allow it to rest on the pinion shaft. **NOTE: Engines built with S&S SA cases will require the installation of a spring adapter PN 31-2103 to support the spring. The large end of the adapter goes into the breather as shown in photo 6a.**

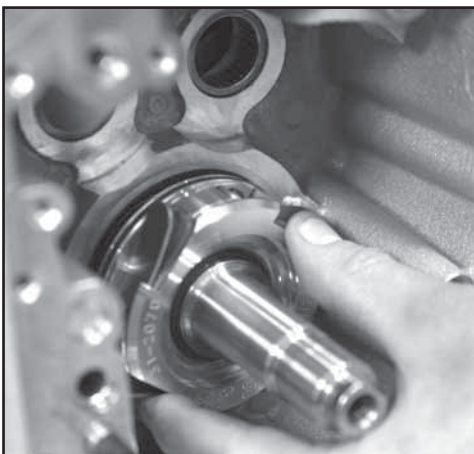


Photo 6

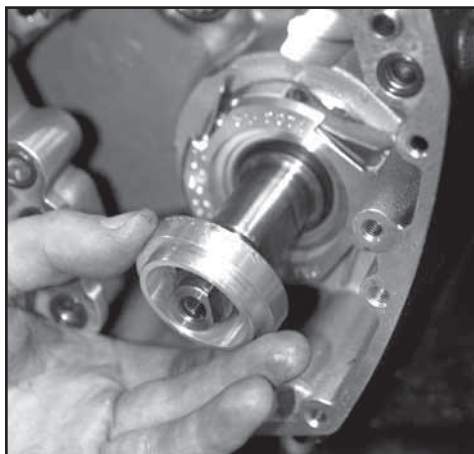


Photo 6a

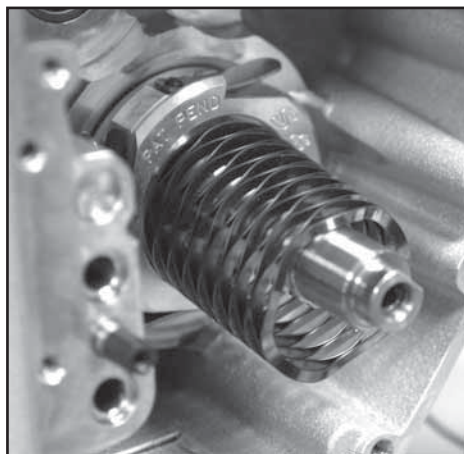


Photo 7

Open the O-ring pack included with the kit and install them around the S&S case perimeter. H-D cases will require only 3 O-rings (early 1999 H-D uses only 2). Be sure not to forget the large O-ring pointed out in the photo below.

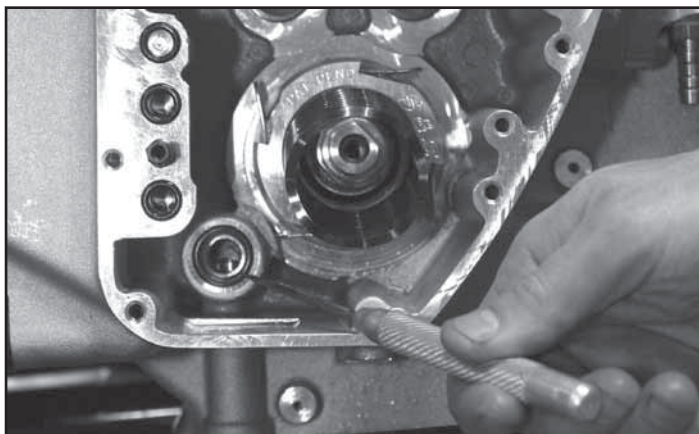


Photo 8

NOTE FOR early 1999 H-D® OWNERS: If your case looks like this (**photo 9**) included in the kit is a plug for the oil pump body. You must install this plug before moving forward.

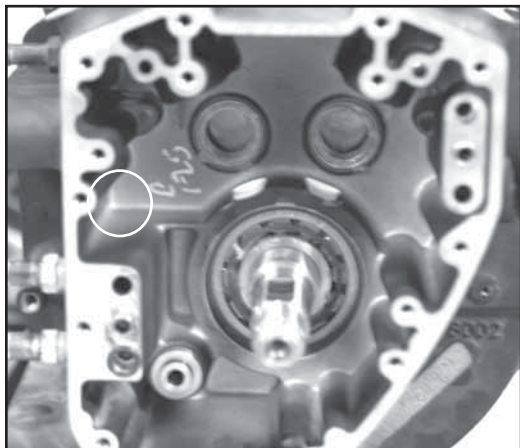


Photo 9



Photo 9a

If you are installing this pump in a stock H-D case you will need to replace the three O-Rings indicated in **Photo 10**. Installation in an S&S® case will require replacing all of the O-rings in **Photo 11**.

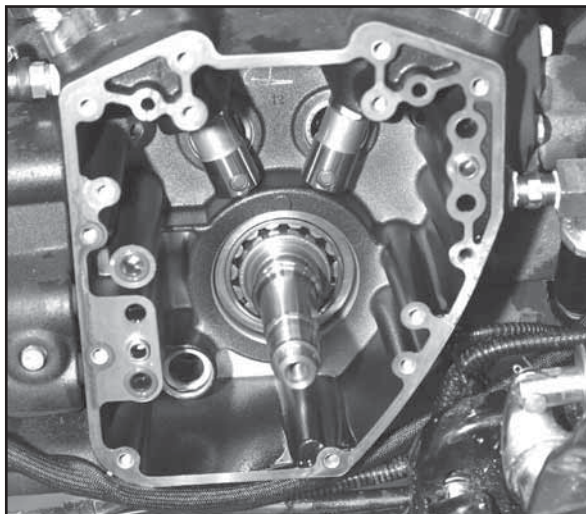


Photo 10

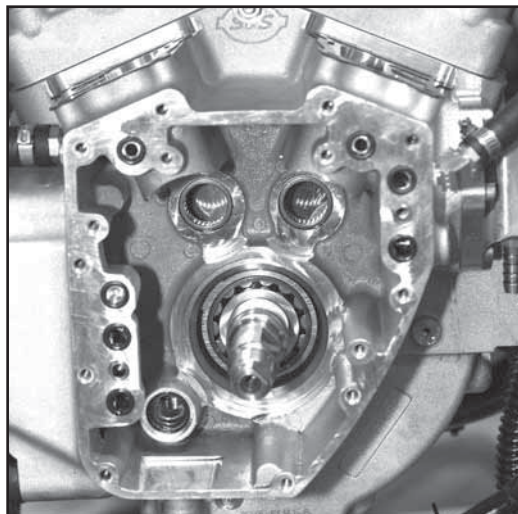


Photo 11

Start by applying some assembly lube to the pinion shaft. Next, carefully slide the oil pump body over the shaft just enough to contact the reed valve spring. Before pressing the pump body in place, verify that the spring is seated in the reed valve groove — or, onto the SA case adapter.

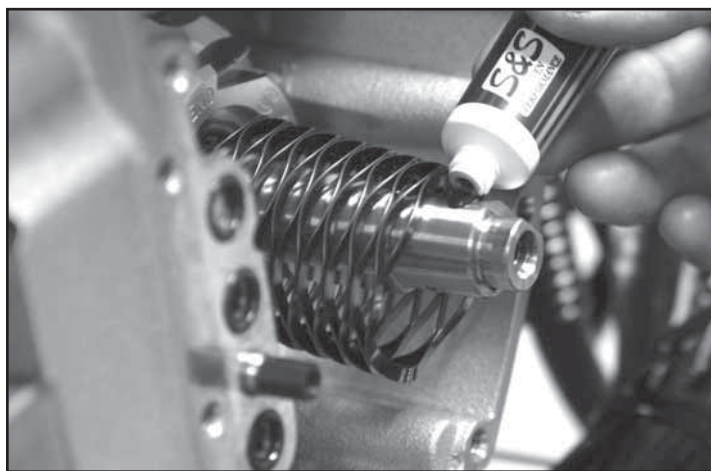


Photo 12



Photo 13

Maintain pressure on the body to hold the spring in place and slide it into position. Once it is in place install a 10-24 x 1" socket head screw in the rear dowel and a 10-24 x ¾" screw in the front dowel. Torque to 60-75-in/lbs. Now you can install the ¼-20 x 1 ¾-inch flathead socket cap screw (95-120 in/lbs) in the countersunk hole in the body. Do not use a threadlock on this screw.

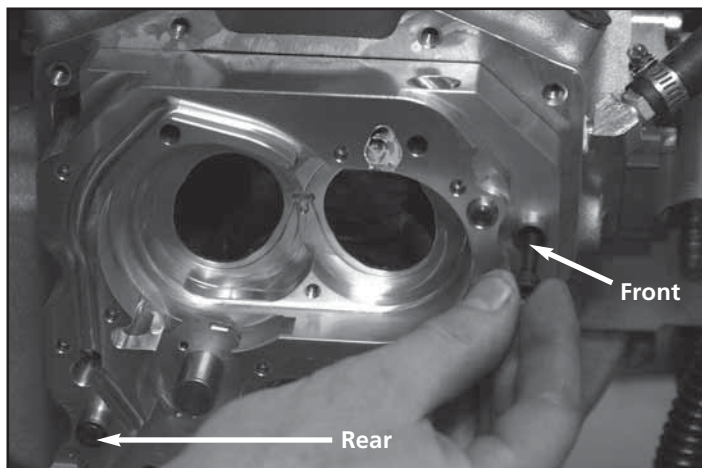


Photo 14



Photo 15

Start the front cam installation (no threads on it) by applying assembly lube on the shaft, lobes and backside of the drive gear. Slide the cam into position through the oblong hole in the body. Note that the hole will allow the base circle and lobes to slide through in different orientations.



Photo 16

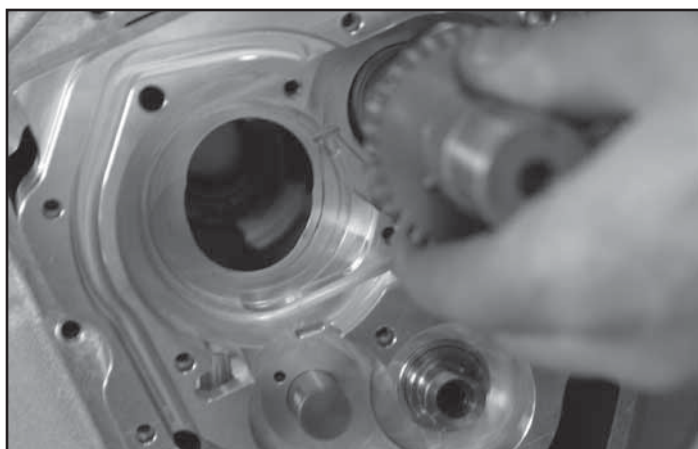


Photo 17

The rear cam is easily identified by the threads on it. Lube the rear cam as you did the front and slide it into place making sure to align the timing marks as shown in this photo.

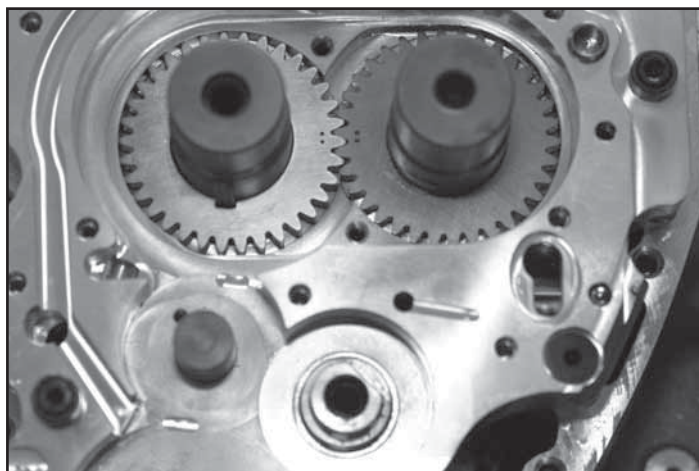


Photo 18

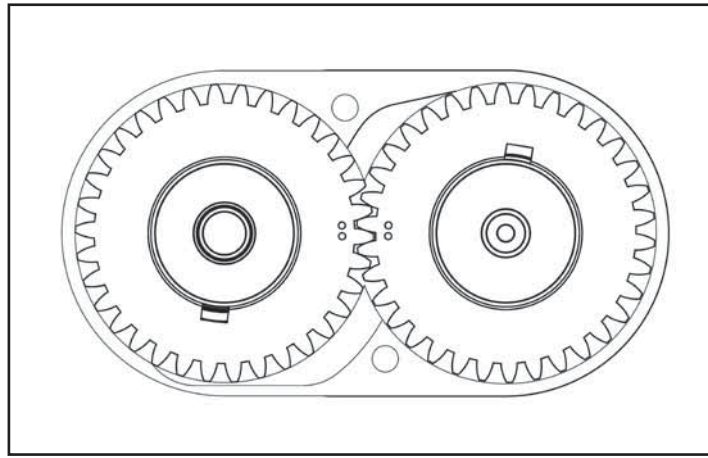


Diagram 1

Apply a coating of assembly lube to the back of the divider plate and use the two 10-24 x ½-inch flat head socket screws (60-75 in/lbs) to secure it. Do not use any threadlock on the screws. Make sure not to apply any weight or pressure on the cams until the cam cover is installed—do not install the tappets or pushrods until the cam cover case is in place. Screw heads must be flush or below the divider plate surface.

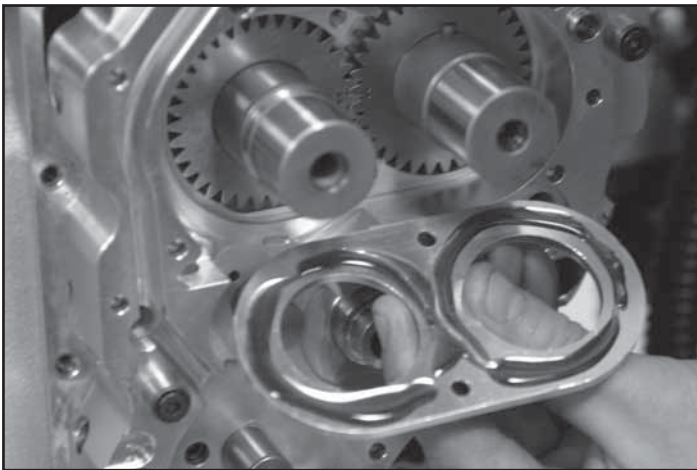


Photo 19

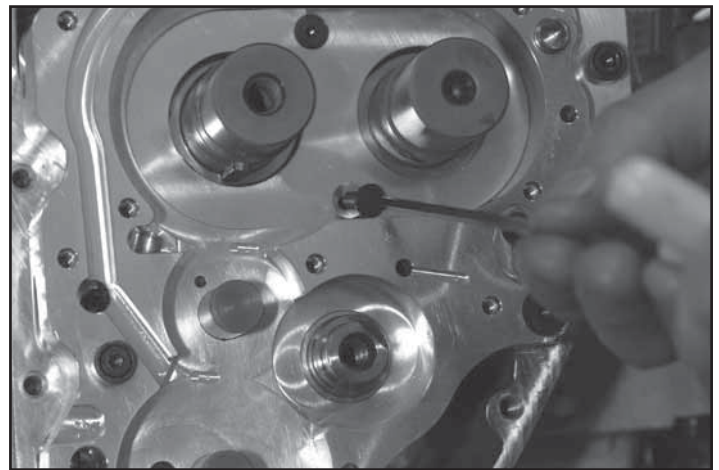


Photo 20

Before you can install the rear cam drive gear, you **MUST** install the gear spacer. It slides on the rear camshaft over the keyway. Install the cam drive gear (timing mark faces out) by sliding a socket larger than the camshaft (typically a 1 ¼" 12-point shallow socket) over it. Use a ⅜-18 x 2-inch bolt with a washer, slide it through the socket drive opening and thread it into the shaft. Tighten the bolt until it presses the gear on deep enough for it to bottom.

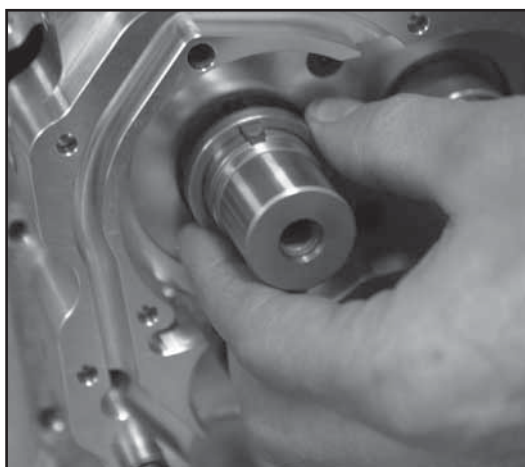


Photo 21

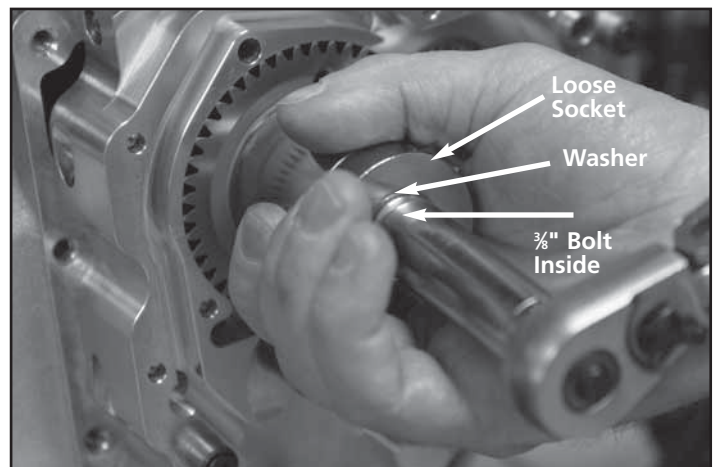


Photo 22

Rotate the rear cam until the cam drive gear timing mark is facing down. Lubricate the idler gear with assembly lube and install it so one of its timing marks align with the rear cam and the other faces the three o'clock position.

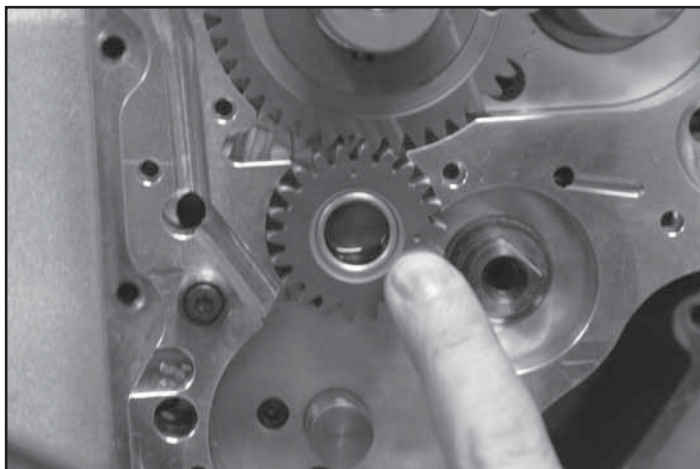


Photo 23

Lube the I.D. and rear face of the cam chest scavenge gear and slide it into place—it has no timing positions.

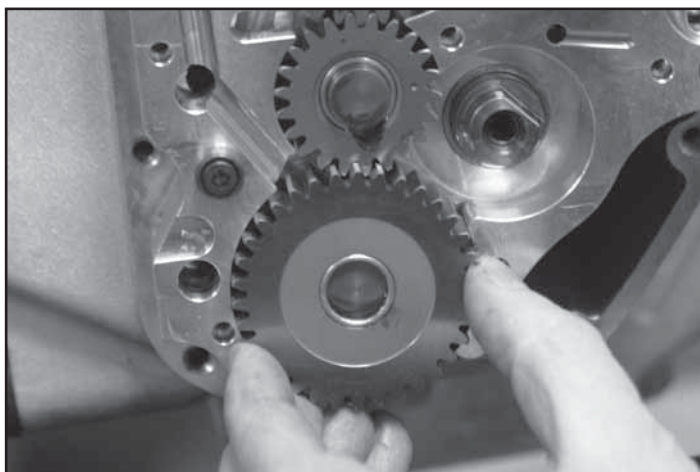


Photo 24

To set the final torque on the rear cam retaining nut, insert a wire-tie into the gears as shown. Then add blue 243 Loctite and tighten the nut to 25 ft/lbs of torque.

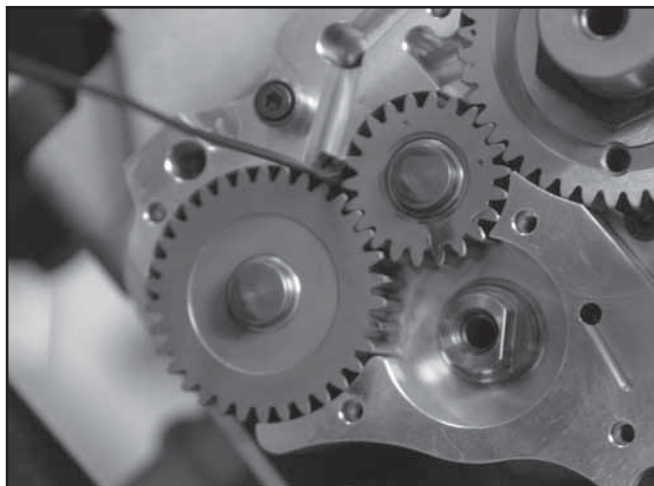


Photo 25

Rotate the crankshaft until the pinion shaft flat is facing upwards. Carefully align the timing marks and slide the pinion gear in place with a wire-tie inserted to lock the gears. Apply a small amount of lube to the underside of the bolt head and red 262 Loctite to the threads. Press the gear into position with the bolt and final tighten it to 25 ft/lbs of torque. DO NOT ROTATE THE ENGINE AGAIN UNTIL THE CAM COVER IS IN PLACE.

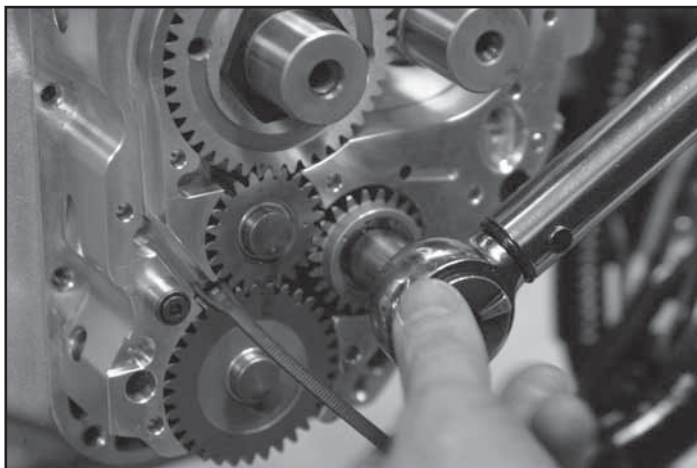


Photo 26

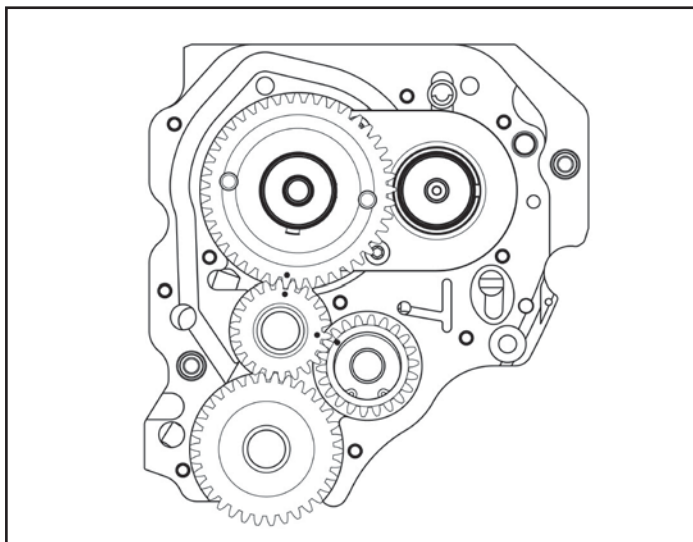


Diagram 2 - Timing Mark Alignment

Install an O-ring in the oblongated pressure relief passage and then apply a coating of assembly lube to all of the gear faces.

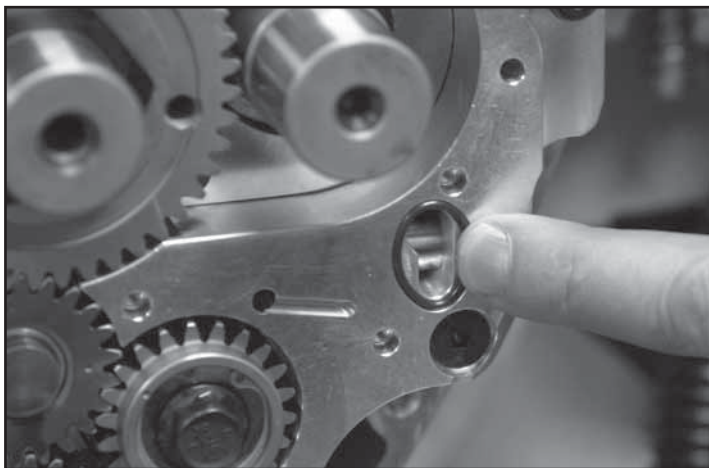


Photo 27

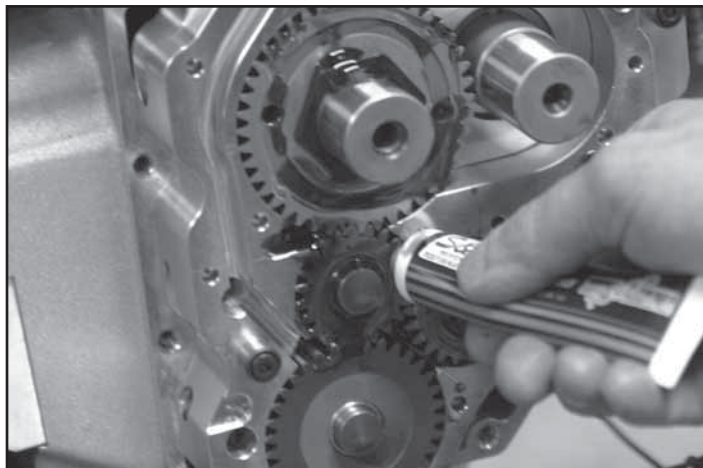


Photo 28

Put a small amount of grease in the pressure relief hole to help hold the 3/8" ball and spring in place (photo 29). When you install the cover plate, verify that it seals tight with no gap as shown in **Photo 29a**.

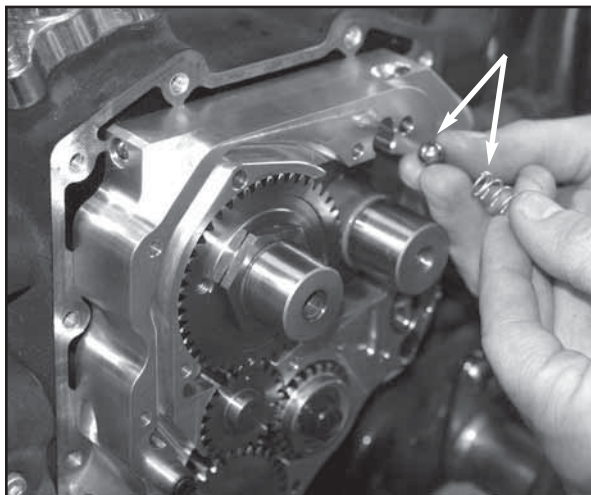


Photo 29

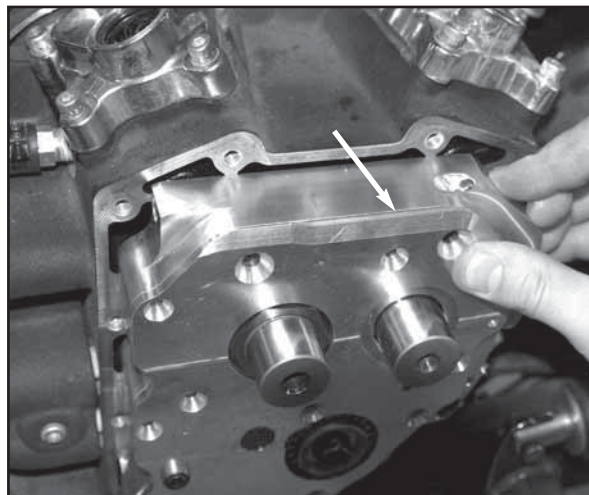


Photo 29a

While holding the cover plate in place, install two 1/4-20 x 2-inch and ten 10-24 x 3/4-inch flat head socket screws following the sequence shown in the diagram below. Torque the 1/4-20 screws to 95-120 in/lbs and the 10-24 screws to 60-75 in/lbs.

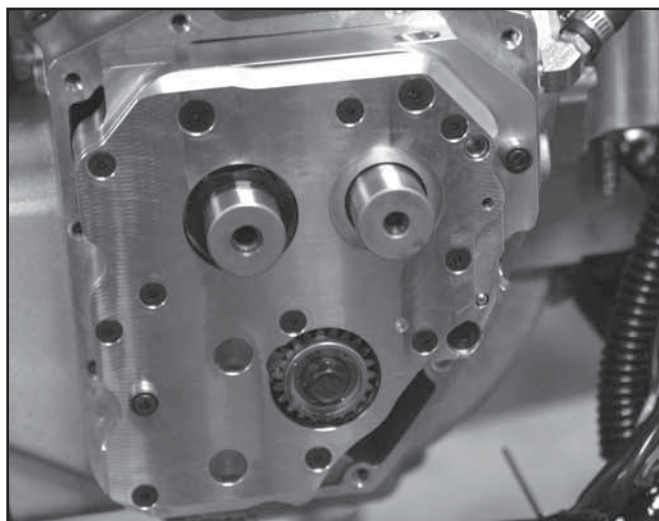


Photo 30

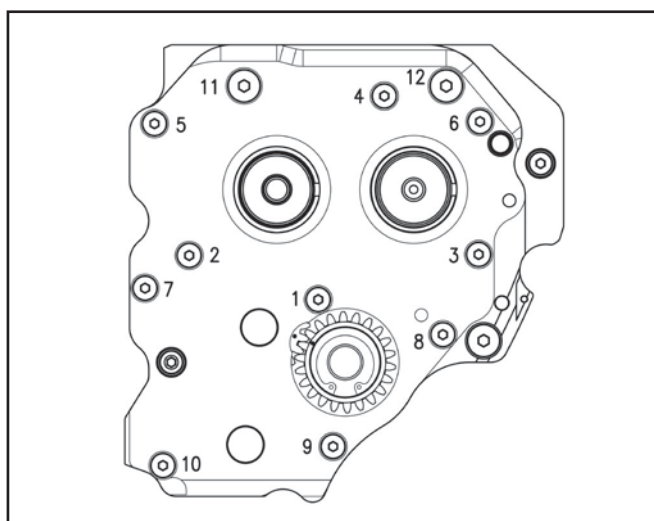


Diagram 3

Before going any further, install the large O-ring in the front cam counterbore. Then slide a new, dry gasket around the pump body.

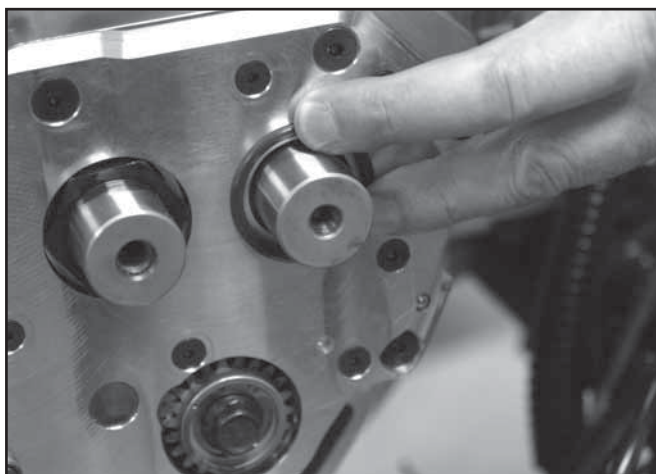


Photo 31

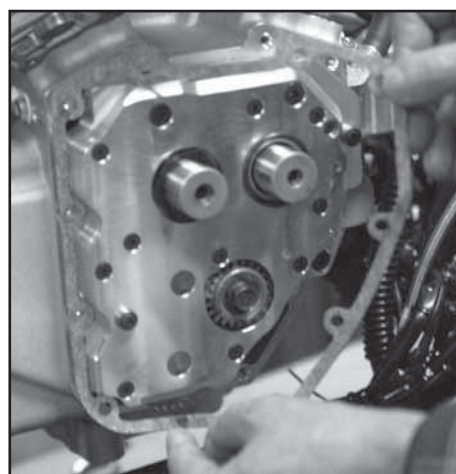


Photo 32

Install both of the included O-rings in the back side of the cam case cover. Next, apply assembly lube to both camshaft ends.

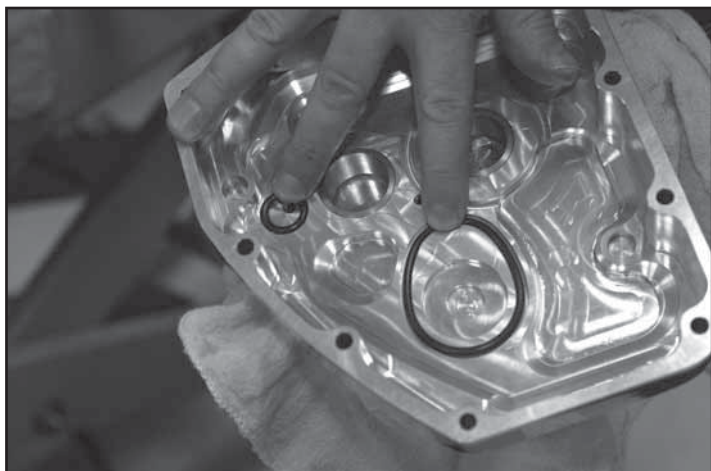


Photo 33

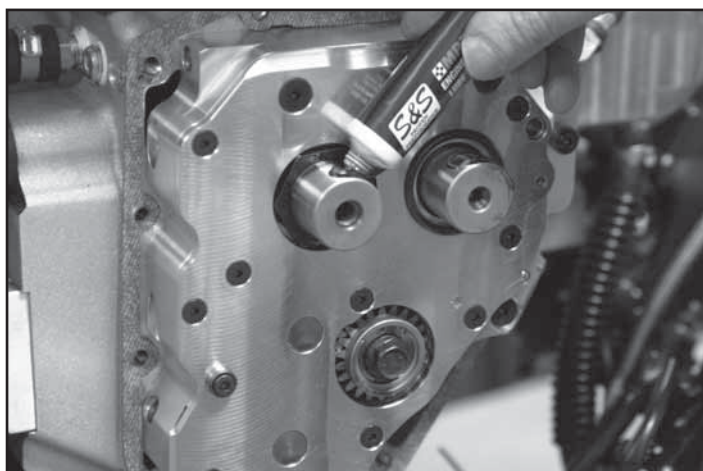


Photo 34

Slide the S&S® cam cover in place and use the supplied chrome screws, washers, and blue 243 Loctite to install it. There are three holes found up top that get the short socket head screws and the rest utilize the long socket head screws. Torque to 95-120 in/lbs in the pattern below.

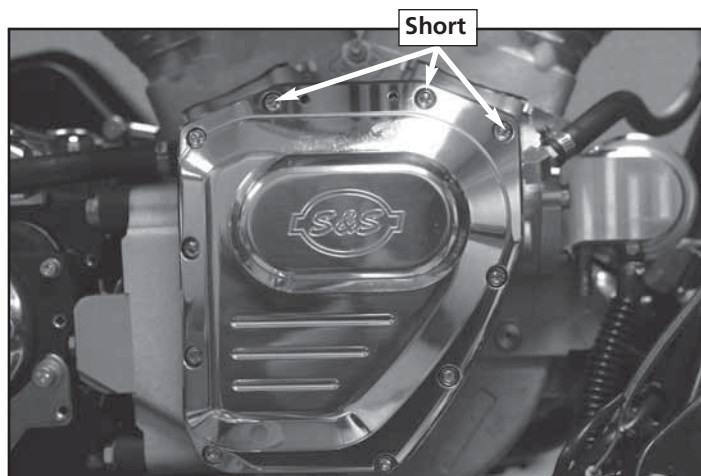


Photo 35

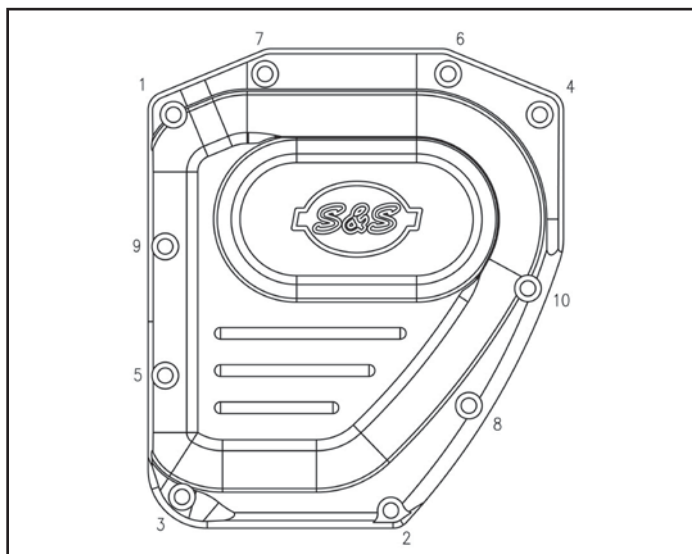


Diagram 4

After assembling the motor check the oil level in the tank. Start the motor and allow it to build pressure to verify that oil is circulating. Shut off the motor and check the oil level again.

CAM SWAP INSTRUCTIONS (Includes Pinion Gear Removal)

Before you can swap the cams, you will need to remove the pushrods and lifters. Next, remove the cam cover and all of the screws in the oil pump cover. Use two flat blade screwdrivers in the pry points on the plate to remove it.

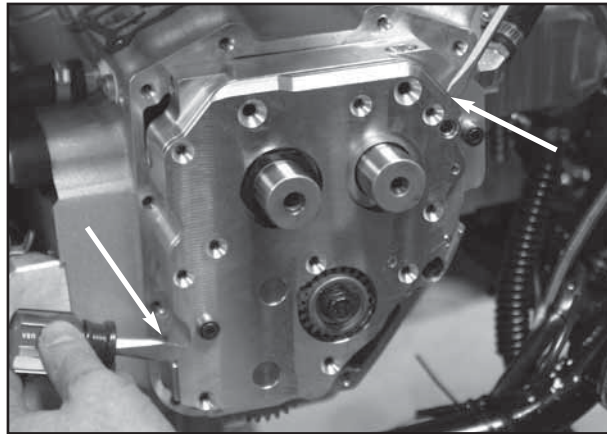


Photo 36

Start by inserting a wire-tie into the gears to immobilize them. Remove the bolt in the pinion gear and then insert two $\frac{5}{16}$ -18 x $\frac{3}{8}$ " set screws into the pinion shaft — be sure the second set screw is flush with the end of the shaft when it is tightened against the first set screw. Follow them with a $\frac{1}{2}$ -20 set screw or bolt and pull the gear off. It is important to use the small set screws to prevent damaging the shaft when pressure is applied don't skip this step.

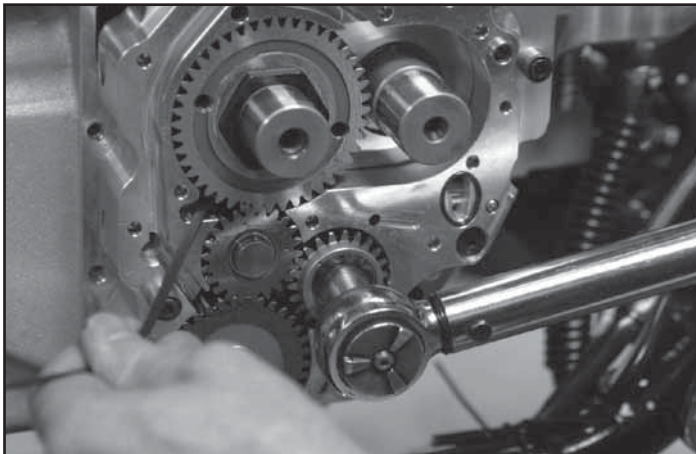


Photo 37

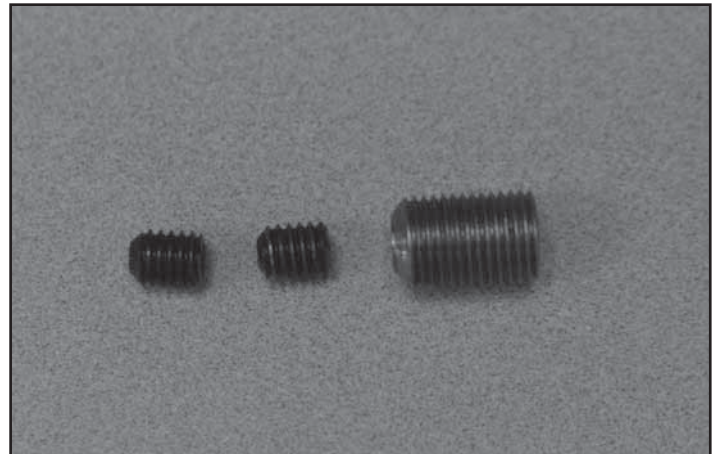


Photo 37a

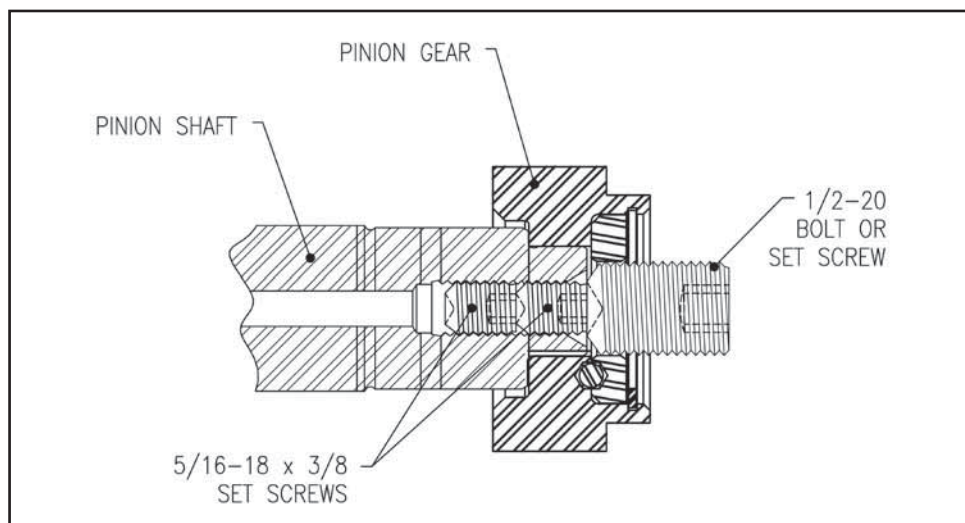


Diagram 5

Use a wire-tie to immobilize the gears again and remove the rear cam retaining nut. Next position a conventional gear puller with $\frac{1}{4}$ -20 threads (maximum thread depth of $\frac{1}{2}$ ") to remove the gear.

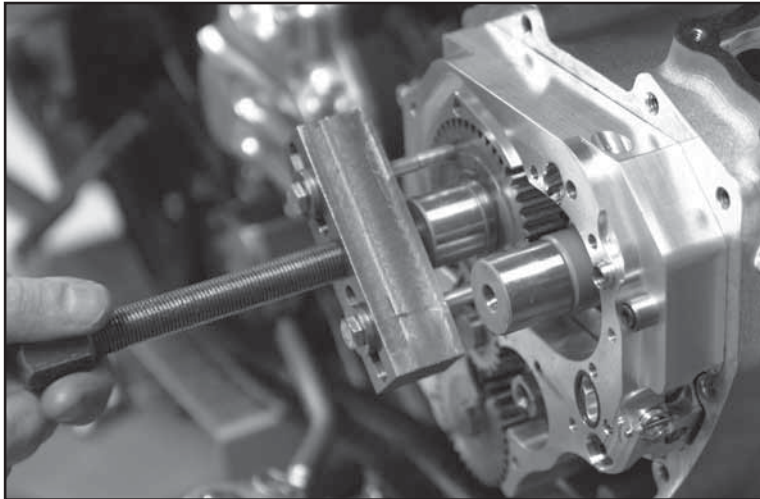


Photo 38

Now remove the screws in the divider plate and pull both cams partially out. This will allow you to lift the divider plate off and then slide the cams completely out. Remove the spacer from the rear cam gear now.

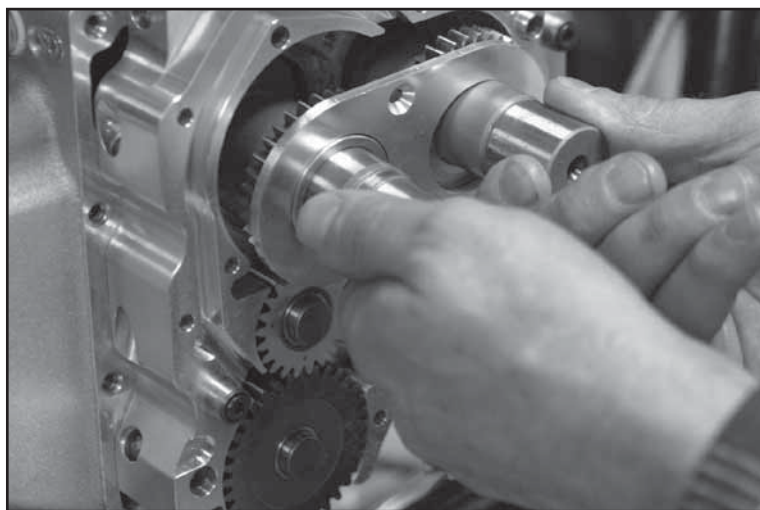
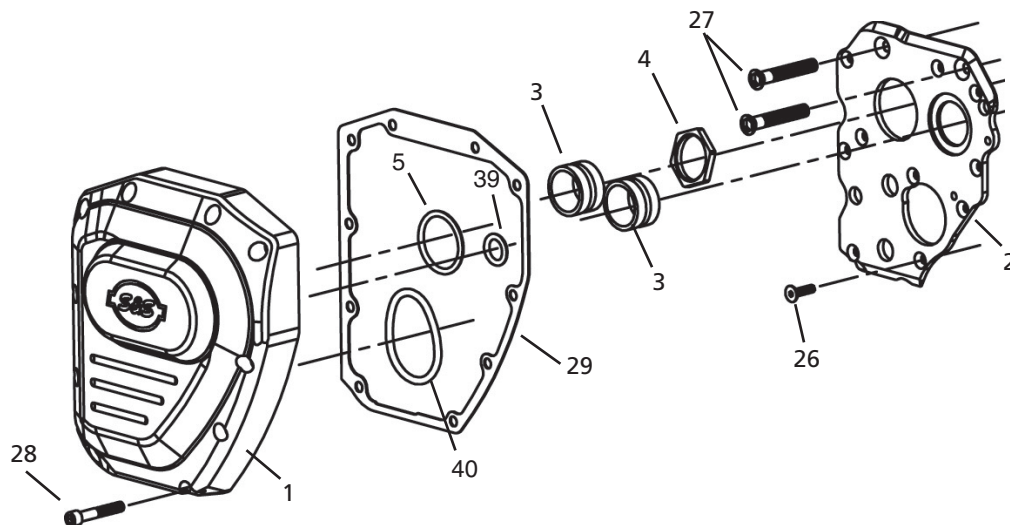


Photo 39

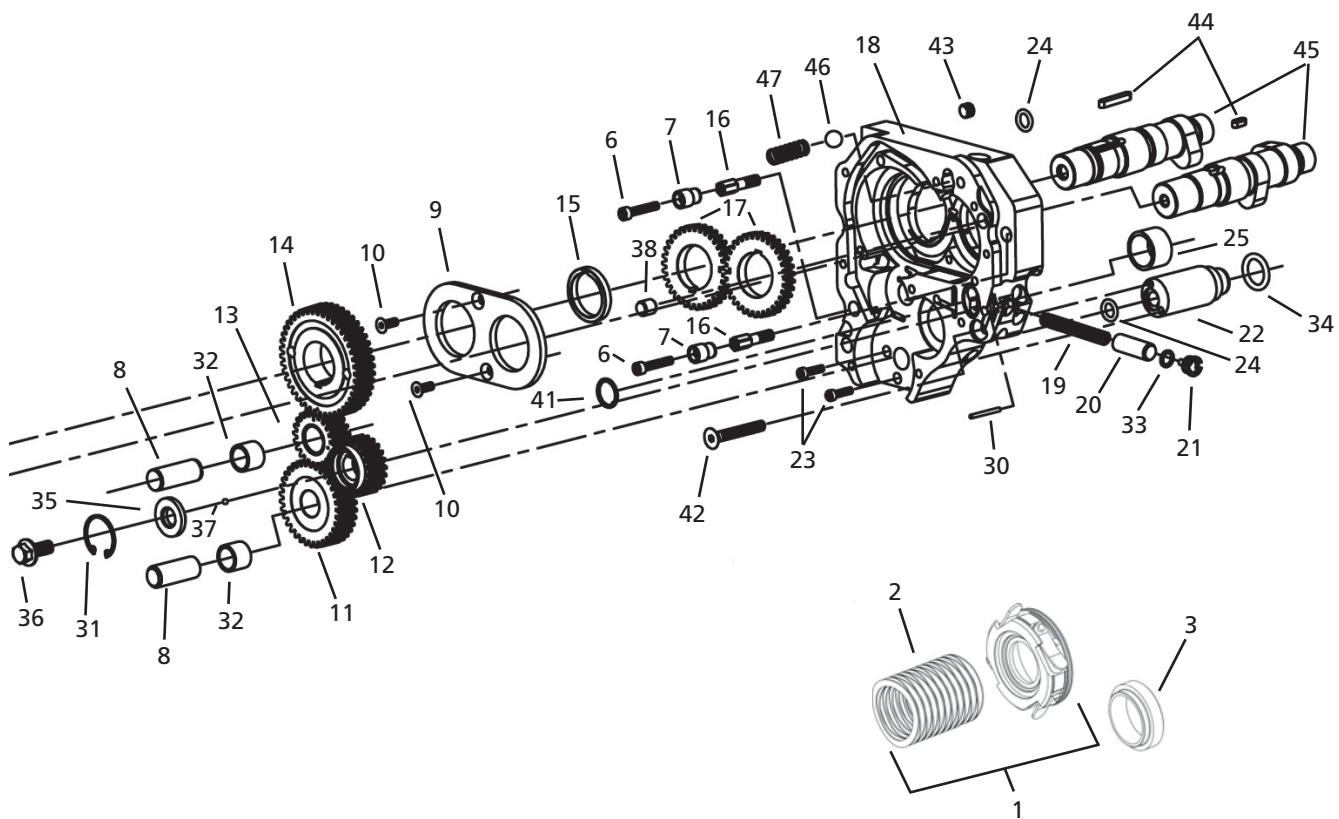
While the cams are out inspect the inner needle bearings and replace if it seems necessary.

Replacement Parts for S&S® Oil Pumps for Twin Cam 88® Engines

1. Cover, Cam Chest, Twin Cam Assembly	31-6506B	27. FHSC Screw ¼"-20 x 2" (5 pack)	50-8163
2. Cover Plate	31-6507	28. Kit, Cover Screw, (Twin Cam Oil Pump)	50-1035
3. Bushing, cam Support (2 pack)	31-4087	29. Gasket (10 pack)	31-2063
4. Nut, Gear Retainer, Rear Cam	31-6511	30. Dowel Pin, ⅜" diameter x 1" (5 pack)	50-8193
5. O-ring, Viton (-220) (5 pack)	50-8245	31. Retaining Ring (5 pack)	50-8241
6. Screw, SHC - 10-24 x 1" (10 pack)	50-0194	32. Bushing	33-4214
7. Alignment Dowel (2 pack)	50-8182	33. O-rings ⅝" OD x ⅙" Viton (-011) (5 pack)	50-8138
8. Idler Gear Shaft (2 pack)	31-2079	34. O-rings (-209) Viton (5 pack)	50-8200
9. Divider Plate	31-6508	35. Washer, Pinion Gear	50-0331
10. FHSC Screw 10-24 x ½" (5 pack)	50-0312	36. Screw, FHHC - ⅝"-18 x ¾" G8 (HD#898A) (10 pack)	50-0149
11. Gear, Cam Chest Return	33-4291	37. Steel Ball, 1/8" (10 pack)	50-1031
12. Gear Assembly, Pinion Shaft	33-4170	38. Pin Dowel - .275" ID x .3745" OD x .397" (HD#16589-99)	50-8148
13. Gear, Idler - Includes item 33-4214 bushing	33-4172	39. Viton O-ring (-207) (5 pack)	50-8244
14. Gear, Cam Drive	33-4292	40. Viton O-ring (-225) (5 pack)	50-8243
15. Gear, Spacer	33-4171	41. Viton O-ring (-16) (5 pack)	50-8242
16. Thread Adapter (2 pack)	31-2089	42. FLC Screw ¼"-20 x 1⅜" (5 pack)	50-0334
17. Cam Drive Gear	33-4293	43. Pipe Plug ⅛"-27 (HD#45830-48)	50-8331
NOTE: For reference only, not included in pump kit.			
18. Body Assembly	31-6505B	44. Key Kit - Cams	50-1038
19. Spring, Pressure Relief (10 pack)	31-6084	45. Cam Kit	See Chart
20. Plunger, Pressure Relief Valve	31-6082	46. Ball, Pressure Relief Valve 3/8" Dia	50-8091
21. Pressure Relief Plug w/O-ring	50-8326	47. Spring, Pressure Relief Valve	50-8408
22. Fitting, Flywheel Cavity Return	50-8183	*Gear Rebuild Kit includes item numbers 11, 12, 13, 14	
23. SHC Screw 8-32 x ⅝" (5 pack)	50-0293 33-4290	
24. O-ring, Viton (10 pack)	50-8066	*Seal Rebuild Kit includes items numbers 5, 24, 29, 34, 39, 40, 41	
25. Bushing, Pinion Shaft	31-4088 31-2097	
26. FHSC Screw 10-24 x ¾" (10 pack)	50-8328		



S&S® Gear Drive Cams For Use with S&S Twin Cam Style Oil Pumps		
Cam*	Cams with Gears & Keys	Cams Only
510GP	33-5220	33-5197
570GP	33-5221	33-5186
585GP	33-5222	33-5198
625GP	33-5223	33-5199
640GP	33-5224	33-5187
675GP	33-5225	33-5189



Breather Valves for S&S Oil Pump for Twin Cam 88® Engines					
		Crankcase			
Item	Description	H-D® 99-02	H-D 03-up	S&S Twin Cam Style	S&S Twin Cam Style Special Application
1	Breather Valve Kit	31-2070	31-2071	31-2071	31-2071
2	Breather Valve Spring	31-2078	31-2078	31-2078	31-2078
*3	Spring Adapter	—	—	—	31-2103

* Spring adapter is used only with S&S Twin Cam style oil pump assembled on S&S special application crankcase.



A complete S&S® Oil Pump Kit (31-6503) for Twin Cam 88® Engines and an S&S Cam Kit (6 to choose from).



Because every industry has a leader