

QUAD CAM

SNOWMOBILE CLUTCH SYSTEM



INSTRUCTIONS and PARTS MANUAL

Designed in 1991 QUAD CAM has established itself as the standard which all high performance snowmobile clutches are compared. Quad Cam can improve performance and tuneability on stock 100hp or custom built 300hp machines. At HRP we run Quad Cams thousands of miles each season on all our trail sleds to further improve our product.

After 12 years there have been many changes, one of the goals is to design current features to fit all Quad Cams in service. HRP can rebuild all Quad Cams with current updates and provide you many years of return on your investment.

Thank You for making QUAD CAM part of your snowmobile investment and fun!



Phone: 616-874-6338

Fax: 616-874-8500

Email: brad@hrpmotorsports.biz

This complete manual is available online at www.hrpmotorsports.biz

Table of Contents

Features	3
Application chart	4
Accessories	5-7
Parts illustration, list	7-8
Installation, Getting started	9-12
Tuning tips	13-14
Adjusting engagement	14-16
Washer adjustments	16-18
Spider service	18-20
Replacing bearings	21
Driven and Chassis setup	21-24
Alignment specifications	25
Belt length vs. center distance	26
Warranty Disclaimer	27
Weight arm chart	28
Springs chart	29
Black Ice Helix chart	30

QUAD CAM FEATURES

Positive Airflow Cooling

By incorporating a cooling method used in a disc brake rotor, cold air enters holes in clutch cover and around shaft in stationary pulley. Then by creating a draft with beveled slots in tower ring and angled ribs inside cover on stationary airflow is created and can be felt on your hand at idle. This design actually draws more cold air past critical areas of the clutch than open face designs and results in cooler operating temperatures at the pulleys and belt. Cooler belt means longer life. See cover pictures.

Explosion Resistant Design

Quad Cam outer half is designed as a shell. By overlapping the tower ring with the cover and moveable pulley the towers cannot expand at high rpm. This exclusive Quad Cam feature is the main reason we have never seen an exploded Quad Cam. No other clutch can make this claim. Quad Cam can rotate at 15000 RPM without failure. While being able to withstand a 15000 RPM spin test is significantly better than any other clutch on the market there are many vibration and runout factors involved when installed on an actual snowmobile and HRP makes no claim that operation at 15000 RPM in vehicle would be safe.



New Spider Design

NEW black Quad Cam spider has special coating which greatly improves strength at hex area by eliminating the clearance at shaft. The slight press fit of the spider eliminates the backlash and prevents wear. Quad Cam still has all the same tuning features with more reliable design including wider rollers for longer life with heavy weight arms. Quad Cam also provides a spider retainer to prevent the clutch from coming apart if the main clutch bolt should break or come loose. See pictures page 18

Quad Cam / Four Lever Design

The name Quad Cam was derived from the use of four weights, rollers and towers to increase the clutch pressure needed to grip the belt and hold high powered machines at proper RPM.

Quad Cams exclusive method of holding the weight arm eliminates the weights wearing on bolts or bushings in arms as seen in other brands. By pressing specially heat treated pins into weight arms and using Teflon bearings on each end of pin Quad Cam eliminates the vibration, wear and noise caused when weight arms become loose.

By sliding the weight arm and pin assembly into pockets the arms can be quickly changed with clutch on or off machine without fighting the spring pressure. See page 12 for details.

Quad Cam design allows you to change only two opposite weights to quickly fine tune your shift RPM. Any combination of full tip, mod tip, different brands or grams can be used. See pictures page 13

HRP, Polaris, Comet or most aftermarket weights and springs can be used for calibration tuning.

Ring Gear Mounts

NEW stationary features mounting boss for starter gears or flywheels. HRP can custom machine to fit any brand ring gear. See pictures on cover

QUAD CAM APPLICATION CHART

Quad Cam Clutch Asm Includes:

Two sets (8) weight pins
 Two spare weight pin bearings
 Spider washers (7)
 Cover washers (6)
 Clutch to engine bolt asm.
 Hex tool
 Instruction book



Weight arms, springs and tools sold separately.
 See pages 5, 28, 29, for lists.

Model and Engine	Part Number	Taper	Bolt Size
<u>Arctic Cat / Suzuki</u>			
440, 500, 530, 580 twin	700-205TAA	5T	1/2-20 X 7"
650, 700 twin 800, 900, 1000 triple	700-20FTAA	FT or ACT	1/2-20 X 7"
2003 large taper 800, 900 twin	700-20CTA	CT	1/2-20 X 6.5"
<u>Polaris / Fugi</u>			
400, 440, 500 twin	700-205TAA	5T	7/16-20 X 7"
Indy 600, 650, triple	700-206TAA	6T	7/16-20 X 7"
XLT 580, 600, triple	700-205TAA	5T	7/16-20 X 7"
Storm 750, 800 triple	700-206TAA	6T	7/16-20 X 7"
<u>Polaris Domestic</u>			
600, 700, 800 twin	700-20FTBB	FT	14 X 215mm
Watercraft triple	700-206T*	6T	14mm washers and bushings only. *
<u>Ski-Doo / Rotax</u>			
340, 440, 521, 583, 617 twin	700-20FTAA	FT	1/2-20 X 7"
1989 Mach One 583	700-20FT	FT	14 X 165mm
1995 and newer large taper 440, 500, 600, 670, 700, 800 twin, 600, 700, 800 triple	700-20MTAA	MT	14 X 153mm
<u>Yamaha</u>			
750, 800 Vmax four cyl	700-205TBB	5T	1/2-20 X 7"
600, 700 triple	700-206TBB	6T	1/2-20 X 7"
RX One 1000	700-206TC	6T	1/2-20 X 6.5"
<u>Arrow Race Engines</u>	700-205TBB	5T	1/2-20 X 7"
<u>PSI Genesis Triple</u>	700-20FT*	FT	14mm washers and busing only.*

* = Special bolt 14mm shank with 12mm thread available from PSI or RAD

QUAD CAM—Tools and Accessories

700-2105 Washers and Hex Tool Kit

Includes:

Cover Washers (2 each size)

Spider Washers (2 each size)

Weight Pins (4 x .250)

Pin Bearings (2)

Hex Tool (1)



700-7103 Hex Tool

3/4" Hex tool used to remove / install spider retainer.



700-7111 Spider Spacer

.150 thick spacer used when wider than standard spider spacing is desired.



700-7136 Oversize Moveable Bearing

Repairs loose standard bearing. Remachining required.



700-7134 Oversize Weight Arm Pins

.251 Pin allows tighter fit to a loose arm bushing than .250 standard pin.



QUAD CAM—Tools and Accessories cont.

701-1015 Stationary / 701-1007 Moveable Pulleys- Wider Belts
HRP can custom machine pulleys for belts wider than 1 3/8". Pulleys should be matched to belt width to prevent belt rising out of pulley at full shift.



700-1013 Cover Bearing Sleeve

Steel sleeve to repair Cover which will not hold bearing. Includes installation into your Cover and new Bearing.



500-3009 Clutch Holding Bar

For holding clutch when removing Clutch Bolt and Spider Retainer. Fits Quad Cam ONLY.



Clutch Puller Bolt

Exclusive Design by HRP uses hardened steel tip which doesn't turn on end of crank while tightening bolt. This allows easy removal of clutch which normal puller would not remove without heating.

500-3009 Puller Bolt 3/4 x 16 US fine thread. Fits older Quad Cam and Polaris.



700-7102 Puller Bolt 3/4 x 20 special thread. Fits 1998 and newer Quad Cams.

Note: No other puller will work.



See page 9 for details how to check which thread you have or contact HRP. Always thread in puller by hand at least 1/2" to be sure threads match.

QUAD CAM—Tools and Accessories cont.

500-3010 Torque Multiplier Tool

Doubles Torque Value of any 1/2" torque wrench.
Use to accurately tighten spider retainer on Quad Cam.



500-3011 Piston Stop

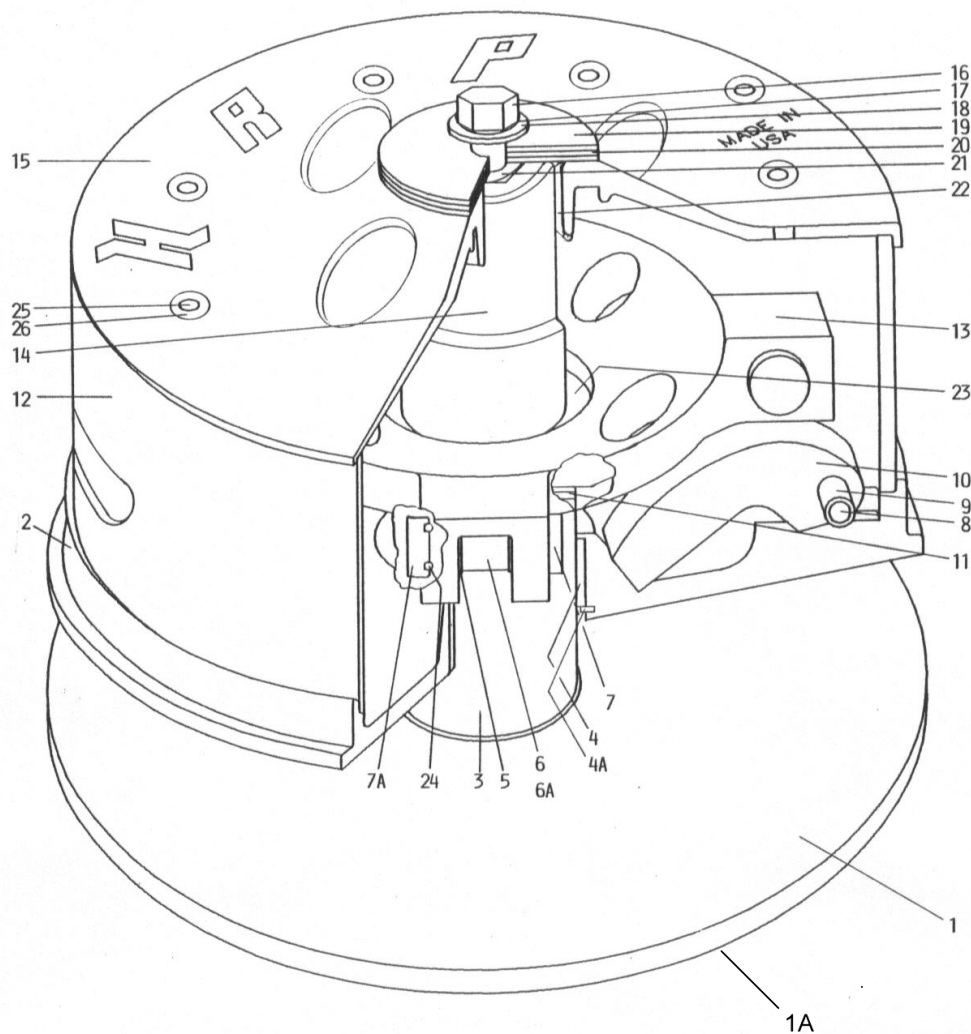
Stops piston at bottom dead center for Lapping clutch to crank. 14mm thread.



Rebuilding Services

HRP offers complete rebuilding services for all brands clutches. We have complete machine shop and balancing tools. Let HRP check over your used Quad Cam and price updates to make good as new.

QUAD CAM ILLUSTRATION



QUAD CAM PARTS LIST

III.	Part No.	Description	Qty.	III.	Part No.	Description	Qty.
1	701-1004	Stationary pulley—1 3/8" belt-2003 draft cooling	1	14	701-1012	Spider retainer—16 thread	AR
1	701-1015	Stationary pulley-wider belts	AR	14	701-1018	Spider retainer—20 thread	1
1A	701-1001	Windage cover-stationary	1	15	701-1001	Cover	1
	700-7112	Screw -windage cover	6	15	700-2102	Cover asm. With bearing	AR
2	701-1016	Moveable pulley— 1 3/8" belt	1	16	500-1131	Bolt—1/2-20 X 7" grade 8	AR
2	700-2103	Moveable pulley asm.—1 3/8" belt with bearing	AR	16	500-1129	Bolt—1/2-20 X 6.5" grade 8	AR
2	701-1007	Moveable pulley-wider belts	AR	16	500-1133	Bolt—7/16-20 X 7" grade 8	AR
3	701-1000	Main shaft 5T	AR	16	417113900	Bolt—14 X 165mm	AR
3	701-1002	Main shaft 6T	AR	16	417120000	Bolt—14 X 153mm	AR
3	701-1003	Main shaft FT	AR	16	7517347	Bolt—14 X 203mm	AR
3	701-1005	Main shaft MT	AR	17	500-1160	Conical washer 7/16"	AR
3	701-1009	Main shaft CT	AR	17	250200005	Conical washer 1/2"	AR
4	700-7129	Bearing-moveable	1	17	250200006	Conical washer 14mm	AR
4	700-7136	Bearing-moveable, oversize	AR	18	5210748	Flatwasher—7/16" - extra thick	AR
4A	700-7130	Spiral circlip	1	19	500-1166	Washer-aluminum-cover 7/16"	AR
5	5430945	Washer-roller-non-coated spider	AR	19	500-1139	Washer-aluminum-cover 1/2"	AR
6	204288	Roller— non-coated spider—.39 wide	AR	19	500-1164	Washer-aluminum-cover 14mm	AR
6	1321717	Roller—black spider—.54 wide	4	20	700-7105	Cover washer-plastic .020	AR
6A	700-7116	Pin-roller	4	20	700-7106	Cover washer-plastic .030	AR
7	5430445	Button-spider	8	20	700-7107	Cover washer-plastic .060	AR
8	700-7125	Pin-weight arm .250	4	21	5430261	Bushing-clutch bolt 7/16"	AR
8	700-7134	Pin-weight arm .251	AR	21	500-1126	Bushing-clutch bolt 1/2"	AR
9	700-7126	Bearing-weight arm pin	8	21	500-1165	Bushing-clutch bolt 14mm	AR
10	polaris	Weight arm—See list	4	22	700-7128	Bearing-cover	1
11	700-7120	Washer-spider .020	AR	23	700-7137	Washer-spider retainer	1
11	700-7121	Washer-spider .030	AR	24	5210733	Shim-button	AR
11	700-7122	Washer-spider .045	3	25	700-7132	Screw -cover— 10-24 X 3"	8
11	700-7111	Washer-spider .150	AR	25	700-7133	Screw -cover— 10-24 X 1/2"	2
12	701-1008	Tower ring-extra cooling	1	26	700-7135	Flatwasher- #10	10
13	701-1010	Spider-black coating— .54 wide roller	1				
13	700-2104	Spider asm.—black with wide rollers and buttons	AR				

INSTALLATION INSTRUCTIONS-QUAD CAM CLUTCH

HRP has developed this information after 12 years of experience with our product. Most of the instructions are the same but some specifications and information may have changed from our earlier instructions. All new info will apply to older Quad Cams in service.

Much of the NEW information will answer many questions that we get calls about and help tuners to develop their own setups.

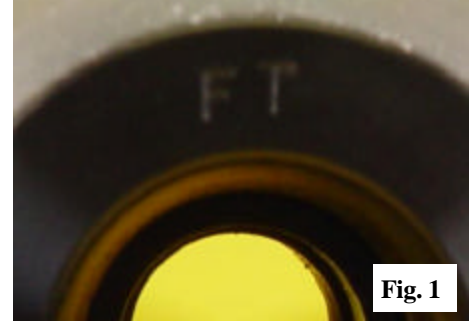
Thank you for purchasing QUAD CAM and please read this manual before you get started. It will save you some time and make using the product more enjoyable.

Getting Started IMPORTANT READ FIRST

HRP assumes that the person installing this clutch has mechanical experience and basic understanding of how the clutch system works. If not please consult a experienced technician or call HRP for help.

All QUAD CAMS are built for 1 3/8" wide belts unless special order was placed for wider belt application. HRP makes special pulleys to match wider belts, call HRP for help.

HRP has installed .135 spider washers that will be good to start using the clutch. Cover washers .120 will be good for trail and .060 for drags to start, see page 16 for washer setting info.



Installation

1) Be sure taper in clutch matches your engine. Look at page 4 and find your engine type and taper size. Next be sure the marks on clutch shaft are same as chart recommends, Fig 1.

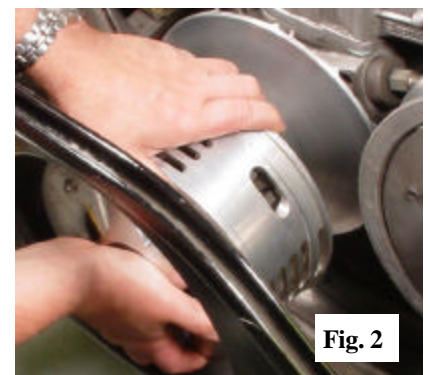
2) Select weight arms and spring. See page 13 for information about how to choose starting size for weight arms. Both weights and spring must be chosen based on previous setup with original clutch or by experience. Call HRP for help if you don't know where to start. See pages 28 and 29 for weights and springs in stock at HRP.

3) See page 12 for instructions how to install pins in weight arms, be sure pins press fit into arm. There are eight .250 pins with each clutch. Four pins and eight bearings are inside clutch with four pins and two extra bearings in parts kit. Be sure pins fit tight into weights, use .251 oversize pins if needed. If still loose replace bearing in weight arm.

4) See page 12 for instructions how to install spring and weights into clutch. Be sure spring and weights fit Polaris, comet and early arctic cat clutches. Most aftermarket weights fit except Heel Clickers which require machining to clutch and are not recommended by HRP. Do not use new style Arctic cat or Yamaha tuning parts.

5) Clean crankshaft taper with scotchbrite or emery cloth until perfectly smooth surface is seen. Next clean crank and clutch taper with towel and remove any oil or dirt.

Fit clutch on engine and check tapers match by holding clutch on engine by hand at outer end and try to move clutch up and down, fig 2. If slight mismatch is felt use medium lapping compound (valve lapping compound) and hand lapp match the clutch to crank. Use piston stop to keep crank from turning page 7. Clean thoroughly and recheck, if more than slight movement is felt contact HRP for help. Lapp matching parts also eases clutch removal.



Installation cont.

6) Install clutch on engine. Normally the clutch and crank should be assembled clean and dry. Our experience has shown some engines cause the clutch to over tighten on crank and become very hard to remove. A couple solutions are first **DO NOT OVERTIGHTEN** clutch bolt, 50lb torque on all bolt sizes is good. Also a light film of anti-seize on taper will help prevent clutch freezing to crank. Assemble dry first, if removal is difficult try anti-seize. If engine has history of clutch being difficult to remove use anti-seize now.

Before installing bolt be sure plastic cover washers are in place to set belt clearance and engagement RPM. When installing bolt hold plastic washers with aluminum washer and tighten bolt by hand until washers are held in place to prevent plastic washer from getting between shaft and aluminum washer, fig 3.

Use hold tool and torque wrench to tighten bolt, fig 4. Check belt clearance after bolt is tight and set based on your use see page 14.

7) Check alignment to driven clutch see page 25. If alignment is correct with stock clutch it will be correct with Quad Cam and should not require adjustment.

8) After first use check spider nut for loosening. See page 18 servicing spider for details. It is normal to tighten spider nut after first use but not continually. **DO NOT OVERTIGHTEN** use torque wrench and check if nut moves before 200lb. is reached, if nut did not move then nut did not loosen and do not tighten further. If you decide to remove anti-seize lube inside nut and use locktite you cannot recheck tightness as suggested.



Fig. 3

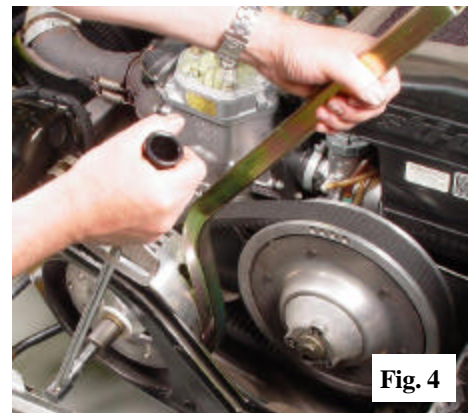


Fig. 4

Removal/Using puller tool

From 1992 to 1997 Quad Cams were built for 3/4"x16 thread pullers same as old Polaris. Due to problems with aftermarket pullers all Quad Cams since 1998 are built for 3/4"x 20 fine thread pullers which are only available from HRP. See page 6 for pullers.

If you have an older clutch and your not sure which thread you have this is how to check. First the puller should thread into clutch easily by hand if threads match, if not look at threads and you can see the difference. Check an old Polaris puller or go to hardware and buy 3/4"x16 bolt to use as test gauge, if clutch matches 3/4"x16 thread you have an older clutch. If the bolt starts a few threads then stops and you can see difference in thread you have newer clutch with 3/4"x20 thread.

NEVER FORCE PULLER into clutch with tools until you can thread puller in at least 1/2" by hand. Always use HRP puller to prevent problems.

USING PULLER first apply anti-seize or grease to puller threads and between tip and shaft. Tip must be free to turn on allen screw and allow tip to stop on end of crank, do not tighten allen screw and stop tip from turning.

DO NOT LOOSEN spider nut or remove outer half before using puller. Thread puller into clutch by hand at least 1/2" then use impact to tighten and remove clutch, fig 5. If clutch doesn't come off easily loosen puller and try again.



Fig. 5

Installation cont.

If impact does not have enough torque use holding tool and breaker bar and tighten to 150lb max, fig 6. After tight apply a few sharp blows to puller end, fig 7. If still wont come off tighten puller then use 1" aluminum or brass bar and apply sharp blows around shaft, fig 8. Do not use heavy blows with hammer, use sharp and solid hits. Hopefully clutch has come off, if not leave puller tight and walk away for a few hours then repeat steps. If nothing else works tighten puller then apply heat with torch to shaft until comes off, usually red hot.

If heat has been used to remove clutch there are several things to fix. Check pulleys for damage and change moveable bearing and retainer in clutch, check crank seal and replace if damaged, inspect taper for galling or welding marks from crank to clutch. This type of damage is caused by a problem with the crankshaft either vibration or out of true. In any case engine should be torn down and inspected.

If your machine has history of clutch being hard to remove use light film of anti-seize on taper to ease removal.

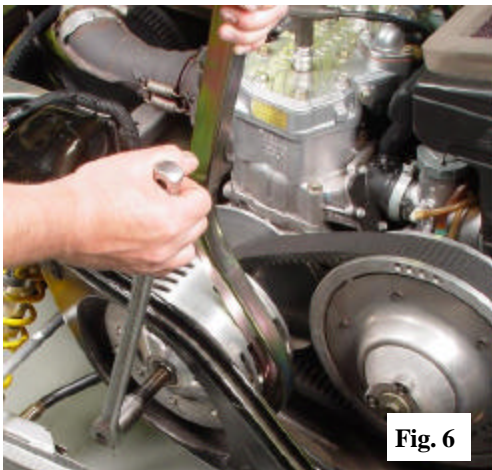


Fig. 6



Fig. 7



Fig. 8

Install Weights and Spring

Install pins in weight arms. Pins must be press fit into arms by carefully aligning tapered end of pin (not radiused end) into arm. Use hammer or arbor press to press in pins fig 9 and 10. Be careful to start pin straight into hole when using hammer. Drive pin until arm is centered on pin, fig 11. If arms have fiber bushings and material is removed from bushing during installation bushing must be replaced.

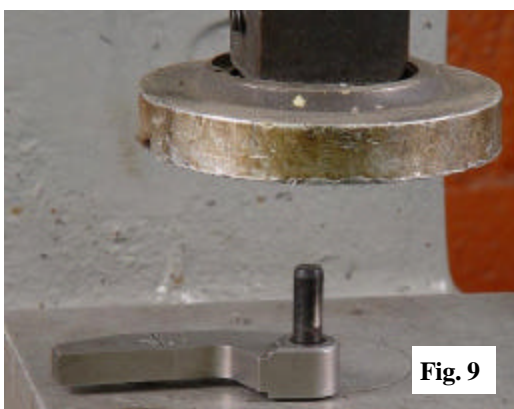


Fig. 9

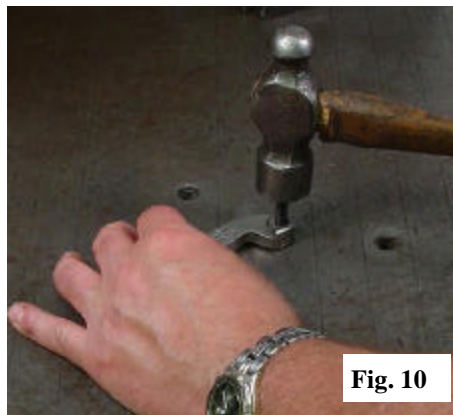


Fig. 10

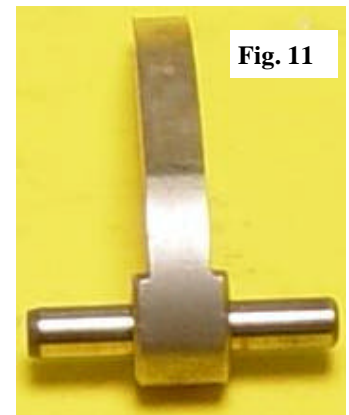


Fig. 11

Installation cont.

PINS MUST FIT TIGHT IN ARMS standard pins are .250 diameter which fit most arms well. If you can move the pins too easily they will move when run and contact the pocket end and cause the arm to bind up which effects clutch performance, fig 12. If .250 pin is too loose use .251 pin and retest. If .251 pin is too loose you can try red locktite but it will be better to replace bushing in arm.

Next remove all 10 cover screws (which are loose on a new clutch) and remove cover. Use plastic hammer and lightly tap moveable pulley away from tower ring which allows access to weight arm pockets and remove weight arm pins and bearings installed at HRP, fig 13 and 14. Next install bearings onto pin/arm. and fit into pockets. Be sure to push bearings to bottom of pocket while tip is away from stop, fig 15. Check that you have installed arms so that opposite arms match, see page 13. Next align tower ring on top of moveable so rollers are on top of weights fig 16 and install 2 long cover screws, tighten then reach under spider and be sure arms move free fig 17. If arms are tight check for burrs on sides of arms as on Polaris letter series weights fig 18, deburr as needed. Also some new Polaris weights are just a few thousandths of an inch wider by mistake, remove pins and grind base to same width as standard. Also if pin is not installed straight, arm will bind and bushing must be replaced.

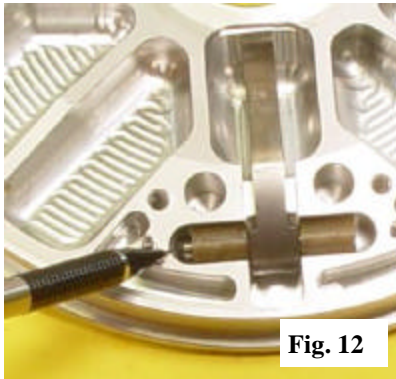


Fig. 12

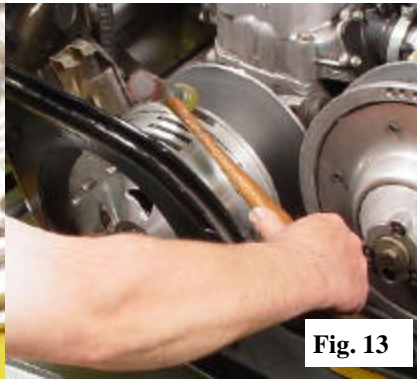


Fig. 13



Fig. 14



Fig. 15

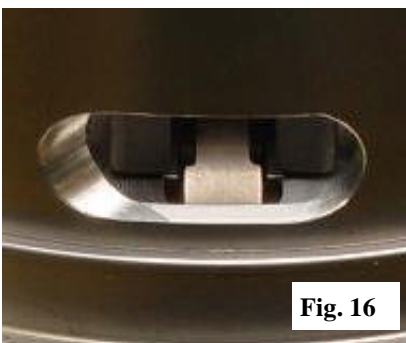


Fig. 16

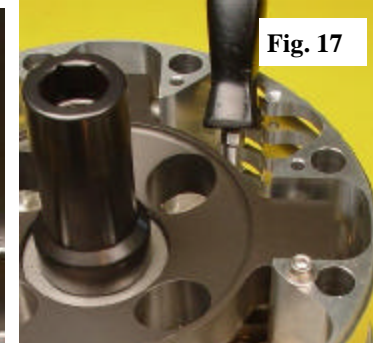


Fig. 17



Fig. 18

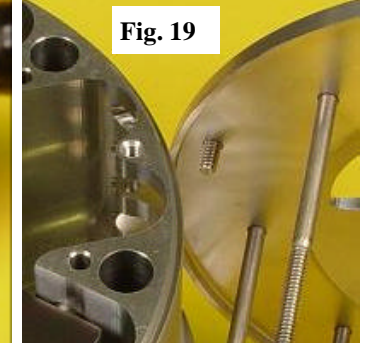


Fig. 19

Next check fit of spring, be sure it fits into pockets of cover and spider properly and is not longer than 1 3/16" when fully compressed. All Polaris, comet and aftermarket springs will work. See page 29 for list of springs we carry.

Next align short cover screws to tower threads and install cover, Fig 19. Finger tighten short screws only then put on bench. Now tower ring is held up and moveable can be dropped away from tower allowing access to change weights while spring is held inside clutch, this is how weights are changed quickly in machine, fig 20. Install long cover screws and tighten with a screwdriver type or T handle tool, DO NOT OVERTIGHTEN and damage threads. Use oil on threads after cleaning to prevent stripping threads.



Fig. 20

TUNING TIPS

Selecting a starting setup for your machine is based more on experience than anything. If you have run this machine with a Polaris style clutch you can use the same spring ,driven setup, 1 3/8" belt and use the weight arm formula to figure a starting point for weights. Test the machine then make changes based on how things work.

Our experience shows the best way to start is to setup the driven clutch first with a helix cam that is standard factory size and stock driven spring and tension for the machine then adjust Quad Cam setup to match driven. After developing some test notes you can see where you may benefit from a different helix or driven spring.

Using helix angles with large angle changes or excessively different angles than stock will cause many tuning problems. While they may fix a bad condition with the original drive clutch the Quad Cam may prefer the driven be closer to stock. See Driven and Chassis Setup page 21.

There is no magic formula or substitute for test and tuning. Many experienced tuners have their own setups that work very well and will work with Quad Cam also but some adjustments to driven setup may be needed to achieve best results.

HRP is happy to help with setup questions from Quad Cam owners, ask for Brad!

Weight Arm Size

The best way to start is by knowing what gram weights worked well in 3 arm clutch then use formula below to convert to 4 arms. If you don't have an idea where to start call HRP for help. Normally Polaris 10 series arms are best to start with. See chart page 28 for sizes.

CONVERSION FORMULA

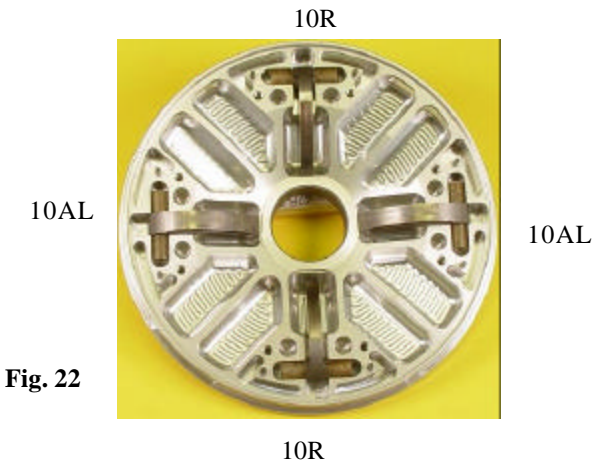
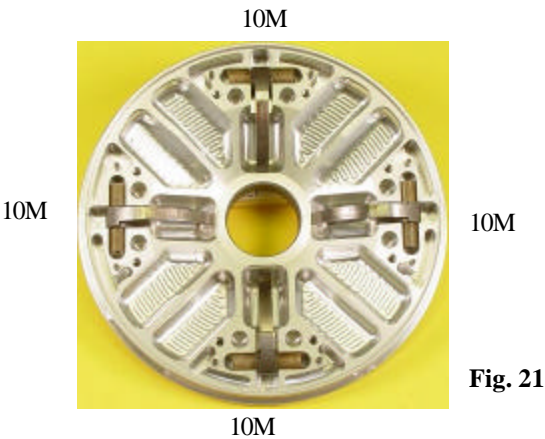
Total the gram weight of a known 3 weight setup then add 12 grams to total and divide by 4. Quad Cam requires the additional grams based on our experience while tuning.

Example	3 x 60 gram arms = 180 grams total
	add for Quad Cam $\frac{+12}{192 \text{ grams total for Quad Cam}}$

192 divided by 4 = 48.0 gram arms
(Polaris 10M x 4)

OR

Polaris 10AL x 2 = 108 grams
+Polaris 10R x 2 = 88 grams
196 grams



The examples above use standard polaris weights to easily reach a starting setup. At this point it is not important that the total grams match exactly with the 3 arm total. Begin testing with a close total then adjust as needed.

Tuning Tips Cont.

Any combination of different weights can be used. Just make sure the two arms that are the same type match within +/- .3 grams. Also be sure matching arms are 180 degrees or directly opposite each other in housing pockets per fig 22.

Change at least 4 grams total per setup change to see a difference in RPM. Combinations of 2 Polaris and 2 comet arms or 2 full tip and 2 mod tip or using only 2 arms are all OK. Just be sure the opposite arms match.

The fastest way to find a good setup is to start with slightly heavier arms then lighten until best performance is reached.

Selecting Spring

Start with a spring which has worked well in other setups you have used or most popular sizes are Polaris blue or comet yellow/green. Both have about 120lb at neutral and 280lb full shift.

See page 29 for list of Polaris and HRP springs in stock.

HRP makes two special springs typically different than any other. Our Gray and Purple spring start at 120 to 150lb neutral and 360 to 400lb full shift. These springs have similar engagement RPM to many others but are significantly stronger at full shift. This allows use of heavier weights which will increase grip on belt at start and improve 0 to 50 mph performance. These springs are especially helpful on large displacement engines with big torque numbers.

Adjusting Engagement RPM

Changing the spring is the most common way to adjust engagement or RPM when machine moves. While this is correct changing the spring pressure also effects the shift RPM at the same time. For example many aftermarket springs increase the neutral pressure 50 to 100lb from stock while full shift pressure remains stock. With 50lb added spring pressure engagement will go up 500 RPM and shift RPM from 0 to 50 mph will be about 500 RPM higher also which will cause loss of performance due to condition called OVERREV or belt slipping. The common solution for overrev is to increase the helix angle size at the start. This will reduce rpm from 0 to 50 mph by allowing driven to open easier and improve performance.

Quad Cam offers several other ways to adjust engagement without changing spring.

Step 1) Adjust plastic cover washers ; Thinner washers will raise engagement

Thicker washers lower engagement

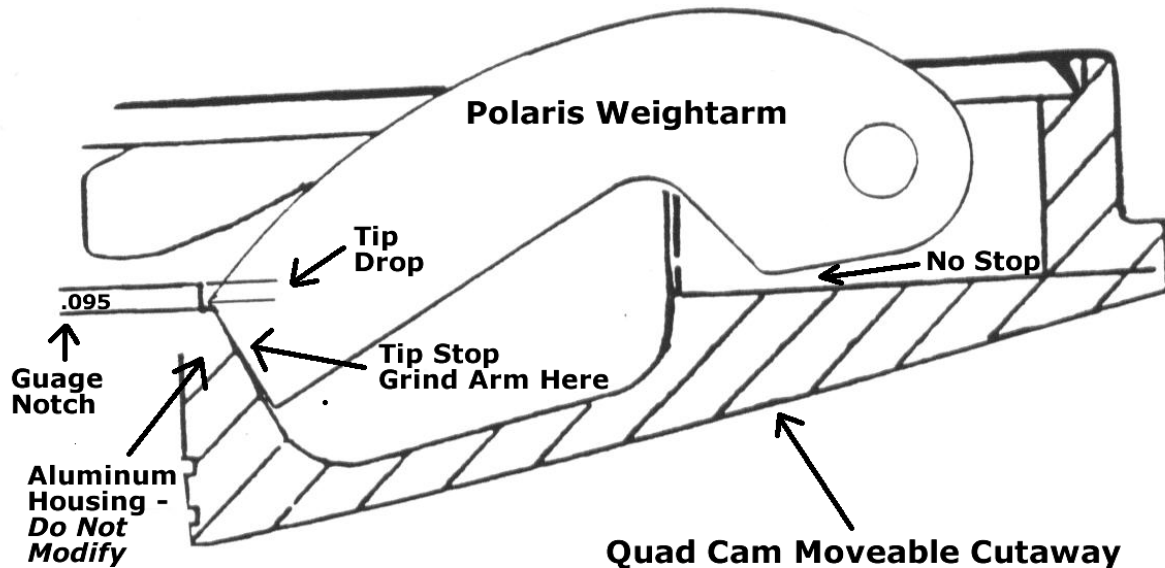
For maximum engagement remove all plastic washers, (for drag racing only)

Adjusting cover washers changes neutral belt clearance at the same time and may require changing spider washers. See Washer Adjustment page 16 for more info.

Step 2) Modify tips of weight arms to increase tip drop, see illustration. This step is used after all cover washers have been removed and higher engagement is still needed. Follow directions carefully and NEVER REMOVE ALUMINUM from housing, modify weight arms only.

DO NOT use heel stops as used on Polaris, arms must stop at tips.

Modifying Weight Arm Tips



Increasing distance tip of arm drops into housing (Tip Drop) raises engagement rpm. By grinding a few thousandths of an inch from the tip of the arm where it contacts the aluminum housing Tip Drop dimension will increase very quickly, fig 23 grind lightly and check often.

Normally the top corner of arm will be just above gauge notch on stock Polaris 10 arms. Modify all 4 arms till corner of arms match gauge notch and test rpm change. To visually check arm position you can see into clutch by following same procedure as changing weights without removing spider. Be sure all cover washers are removed to test. If engagement RPM is higher than you needed but less than 7000 RPM add cover washers to reach desired RPM.



Maximum tip drop measurements for stock (no grinding anywhere) Polaris weight arms have been tested to allow arm to swing towards roller. If too much tip drop is reached arms will try to swing away from roller and clutch will not engage at any rpm. If you want to measure tip drop with tools spider will need to be removed, see instructions page 18.

Maximum Tip Drop	Polaris Letter (full tip) arms = .080
	Polaris 10 (mod tip) arms = .150

Polaris letter (full tip) arms are very close to max tip drop stock, go a little and test. If too much material is removed from arm just spot weld to tip fig 24 and regrind to proper setting. Be sure all 4 mod tip arms are modified to same tip drop, if 2 stock arms are installed engagement will be lower, all 4 arms must have same tip drop to keep correct engagement. When using a combination of 2 full tip and 2 mod tip arms be sure to maintain .080 max tip drop dimension on full tip arms.



HRP has not tested any comet or aftermarket weight arms for tip drop modifications.

MAKE SURE YOU UNDERSTAND THESE DIRECTIONS, ENGAGEMENT OVER 7000 RPM IS DANGEROUS AND NOT RECOMENDED.

Adjusting Engagement RPM cont.

Step 3) Install washers under spring to increase pressure. This adjustment will make small changes in engagement and effects entire shift RPM. Washers are not available from HRP but can be made from Polaris or other driven washers. Washer must be installed at spider end of spring and slide over spider retainer, DO NOT put under spider retainer. Installed spring height must be measured before adding washers.

Measure installed spring height after correct spider washers have been installed and spider retainer is tight. Remove cover and drill 7/32" hole through cover where spring seats, fig 25. With spring removed install cover and tighten 2 long cover screws. Next be sure clutch is at full shift, pulleys touching at base then measure from top of cover to spring seat at spider, fig 26. Measurement must not be less than 1.440". Add washers as needed then recheck and be sure measurement is 1.440" or longer.

NOTES: 1.440" outside cover equals 1.190" spring height inside clutch.

IMPORTANT: If you add spider washer you must remove the same thickness spring washer to maintain proper spring height.

Washer Adjustments

By changing thickness of cover and spider washers tuner can adjust engagement RPM and shift pattern for different type machines and uses. For example the setup for trail riding on most machines will be 4000 to 4700 RPM when machine moves with a smooth increase in speed as throttle is opened and maintains peak RPM whenever at full throttle from 0 to top speed in all snow conditions and have good throttle response, "backshift". All Quad Cams are preset for this use unless special instructions were given with order. The standard setting is the best starting point for drag racing or trail unless you have experience with Quad Cam and know what washers you want or HRP has other recommendations for your machine.

Understanding Terminology

Neutral = Clutch position with engine at idle.

Engagement = Engine RPM when clutch first moves to the belt.

Machine Moves = RPM when machine just starts to move when slowly applying throttle.

Peak RPM = Full throttle RPM of engine at top speed.

Shift RPM = Full throttle RPM from start to top speed.

Overrev = RPM going higher than desired peak RPM of engine.

Backshift = Throttle response or RPM recovery time when throttle is released then quickly back full throttle.

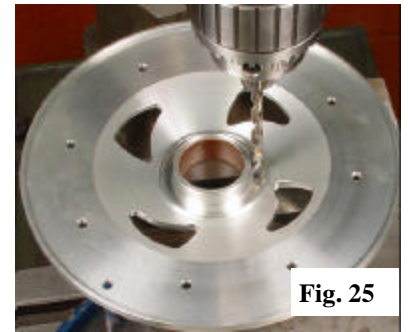


Fig. 25

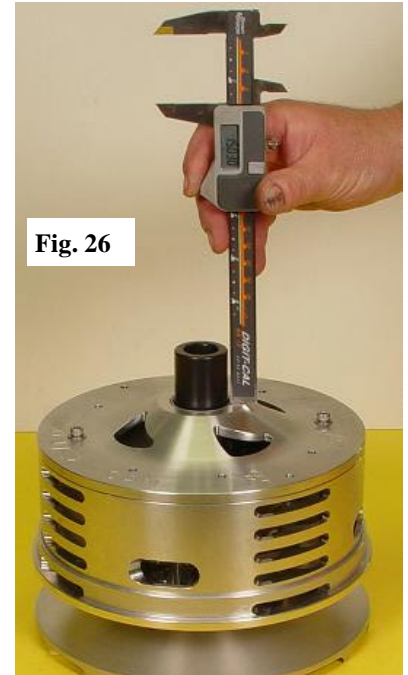


Fig. 26

Washer Adjustments cont.

To further explain engagement there are two positions of the clutch before machine begins to move. ONE, starting in neutral increase RPM till clutch moves = Engagement. TWO, when clutch hits belt and moves machine. Usually RPM will be lower when machine moves than at engagement. This will change with type of belt and clutch setup.

Cover Washers fig 27

Primary use for cover washers is adjusting Engagement RPM.
Secondary use is adjusting belt clearance.
Standard washers in clutch from HRP 2 X .060 = .120
Washers in kit 2 X .020 + 2 X .030, use different combinations to adjust

Higher Engagement = Thinner Washers
Lower Engagement = Thicker Washers

For drag racing when using wider belt clearance changing cover washer will change neutral engagement without changing shift or peak RPM. Set engagement and see spider washer info.

For trail use check belt clearance with two standard .060 cover washers installed and clutch bolt tight. Use .020 cover washer as gauge and adjust cover washers till .020 belt clearance is set, fig 28

Be sure to hold plastic washers with aluminum washer while tightening bolt see page 10.

Spider Washers fig 29

Primary use for spider washers is adjusting belt clearance.
Secondary use is to change machine moves and shift RPM.
Standard washers in clutch from HRP 3 X .045 = .135
Washers in kit 2 X .020 + 2 X .030, use to fine tune for drag racing only.

DO NOT use .020 or .030 washers for trail setups,
up to 5 x .045 can be used. Or .150 + 2 x .045 = .240 max.

For drag racing where neutral starts are most common (holding RPM just under engagement till green) Set engagement with cover washer then check belt clearance, fig 28. Usually the standard .135 spider washer and .060 cover washer is a good place to start and should have about .080 belt clearance with 1 3/8" belt. Test with this setting then adjust. First change cover washers to find best engagement setting then change spider washers to adjust shift RPM. If you want lower shift RPM or need more grip on belt the first 100ft add .030 spider washer to see a change, you can use up to .250 total spider washers but a lot of belt clearance will be very aggressive at start, remember you have to stay on to win. Also try to keep engagement around 5000 RPM minimum to help grip on belt at start.

For trail or any use where smooth clutch engagement is wanted start with standard .135 spider washers and adjust cover washers to have .020 belt clearance with 1 3/8" belt, fig 28. After testing if you want to lower shift RPM in first 100ft add a .045 spider washer then add the same amount to cover washers which will keep .020 belt clearance. When you add spider washers you will also lower machine moves RPM along with lower initial shift RPM. Test and tune to find your best setup.

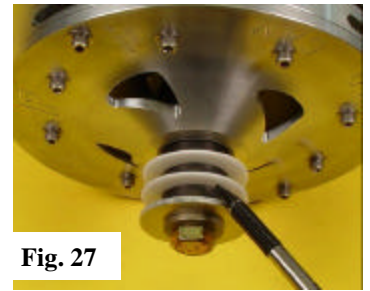


Fig. 27

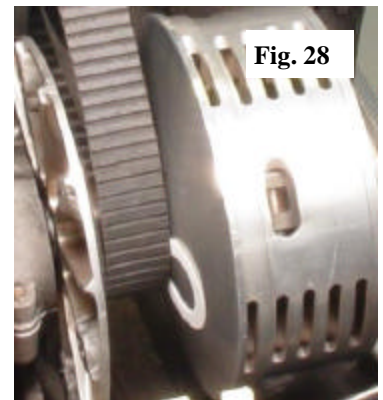


Fig. 28

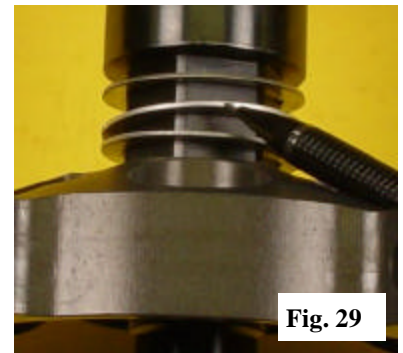


Fig. 29

Washer Adjustments Cont.

Spider Washer Notes: DO NOT use .020 or .030 spider washers for trail or anything except drag racing when retainer can be checked often. We have seen .020 and .030 washers compress during use and cause spider retainer to loosen.

Maximum spider washers thickness is .250 and we have a .150 thick shim P.N. 700-7111 when you want to go thicker than .135 washers supplied.

Quad Cam spider no longer slip fits to hex on main shaft. See servicing spider information for instructions how to remove spider, page 18.

Spider Removal/Service

All Quad Cams built since Jan 2000 are built with black spider which no longer has slip on fit to shaft. The hard coating prevents hex from wearing and the .0005 to .0010 press fit to shaft has eliminated backlash and prevents spider retainer from loosening. Also changed are wider rollers which are more durable with heavy weights. All old style spiders can be replaced with new style.

To remove spider first remove clutch bolt asm then loosen spider retainer (snut) while clutch is on engine, fig 30. Use 3/4" hex tool in end of shaft to attach tools then turn snut counterclockwise to loosen. It is helpful to have clutch held by engine or some type of bench mount tool while using HRP holding tool to stop clutch from turning while loosening or tightening snut, fig 31. DO NOT use Polaris bench mount without using hold tool to prevent loosening stationary pulley on shaft. All Quad Cams assembled at HRP have anti-seize lubricant on snut thread and shaft end. Snut should come off easily once loosened. If locktite has been used in place of anti-seize snut must be heated nearly red hot to release locktite and allow snut to be loosened.

After snut is off remove washer under snut and remove weight arms. Hold clutch in one hand just a few inches off bench top and use large plastic hammer to drive shaft out of spider, fig 32.

BE CAREFULL to hold clutch over bench top to prevent stationary half from falling on floor. Spider should be fairly tight and requires heavy blows from large PLASTIC hammer to remove.

When shaft is out you can change spider washers, fig 33 or complete disassembly to clean or service spider. Before removing spider from tower ring check button clearance with feeler gauge, remember clearance and see Fitting Buttons on page 20 for more info. Remove spider from tower and check rollers, if you see fiber string coming out the end of roller or it seems loose on pin compared to others replace only the bad roller. It is common for one roller to go bad while others are ok. See Spider Rebuilding for more info.

If you are replacing an older uncoated spider with black spider on original shaft be sure you clean hex area with wire brush and remove any aluminum buildup then file chamfer at leading edge of hex, fig 34 to prevent damage to coating when installing new spider.



Fig. 30

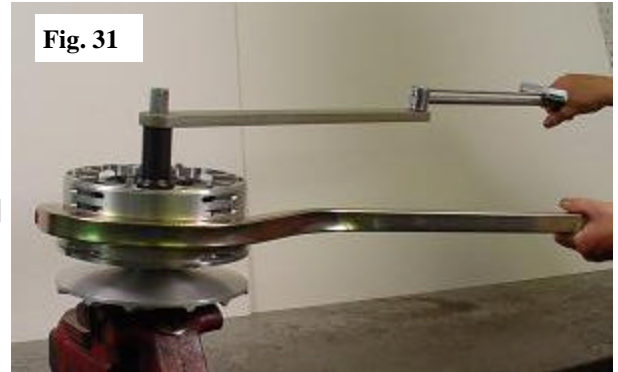


Fig. 31

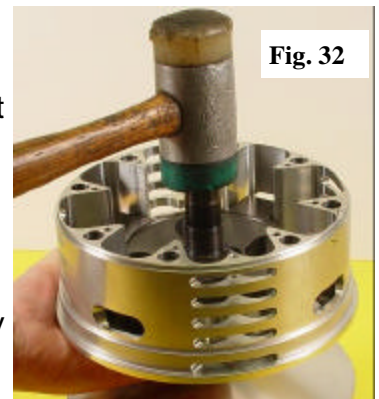


Fig. 32

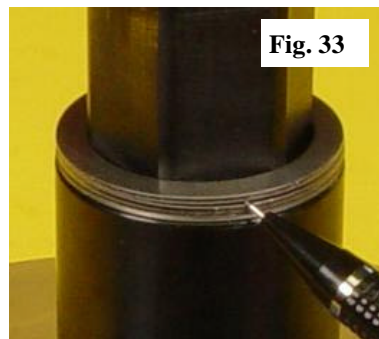


Fig. 33



Fig. 34

Spider Installation

For reassembly be sure spider washers are correct and there is a light coating of anti-seize on shaft hex, thread and small end, fig 35. Next be sure spider fits into tower, spider should move free in tower, if not see spider rebuilding.

Next fit moveable pulley, tower ring and spider onto shaft then use 1 1/8" deep socket to drive spider onto hex, fig 36.

Hold moveable pulley up to keep tower aligned with buttons then drive spider on, fig 37.

As socket gets to hex you will need to align socket with hex as you drive spider, fig 38.

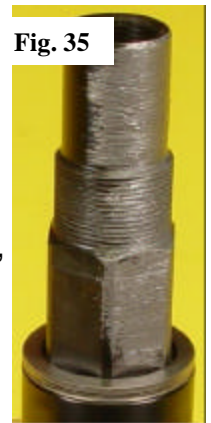


Fig. 35



Fig. 36



Fig. 37

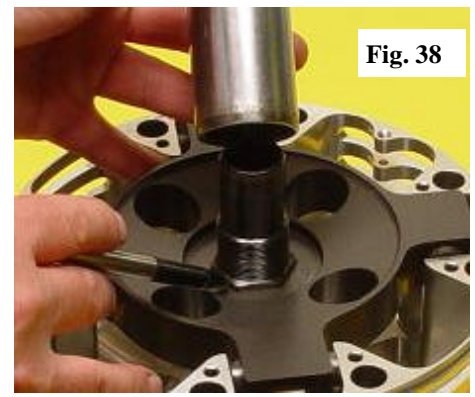


Fig. 38

Before installing snut check threads match. In 1998 we changed the snut threads from 1 1/16" x 16 to 1 1/16" x 20 thread, fig 39.

If you are replacing parts or switching outside halves make sure the snut goes on shaft by hand all the way to spider, DO NOT FORCE snut on shaft, use tools to apply final torque only.

After you are sure threads match install washer under spider retainer then install snut. Use tools as shown to apply 200 ft/lb torque to snut, fig 40.

It is important to know that you are doing torque accurately, use HRP torque multiplier to double value of any 1/2" drive torque wrench. (when torque wrench reads 100lb snut is at 200lb) By accurately torqueing snut you can recheck if nut is loose after running clutch. Put mark on snut and washer, fig 41 then recheck 200lb torque value, if snut does not move at marks then snut did not loosen. Do not over tighten, damage to spider retainer will result.



Fig. 39



Fig. 40

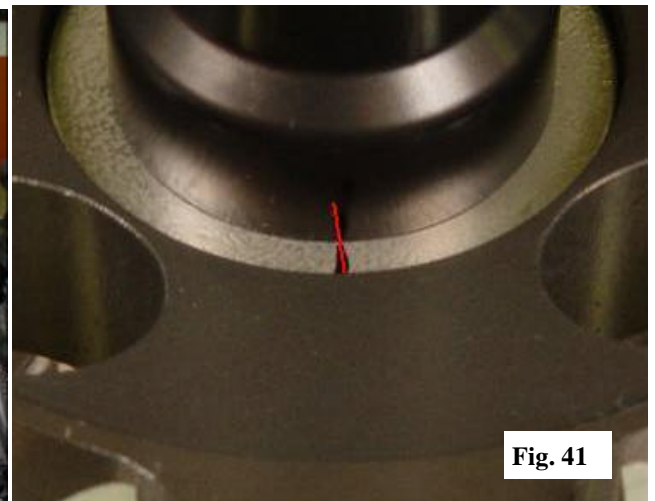
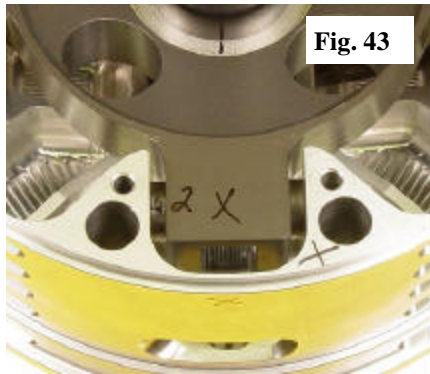
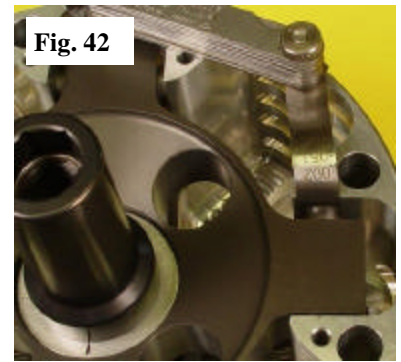


Fig. 41

Spider Rebuilding

When Quad Cam is new it is very quiet at idle. Most clutch noise is caused by too much clearance at buttons and can be corrected by shimming buttons. Earlier we measured button to tower clearance, fig 42.

If clearance is .008 to .010 clutch will be noisy and shims can be installed under buttons to bring clearance back to .001 to .003. If clearance is more than .010 replace buttons and remeasure then shim as needed to get .001 to .003 clearance. Clean clutch thoroughly before doing final measurements. Next mark X at tower and spider then remeasure and write clearance on spider at nonloaded button, fig 43.



Each shim PN 5210733 is .002 thick, add shims as needed to keep .001 to .003 clearance and always add shims under nonloaded buttons only, fig 44.

Keep X aligned and check each tower to button set as shims are installed, fig 45.

Be sure buttons are fully in spider with steel hammer before an accurate measurement can be done, fig 46.

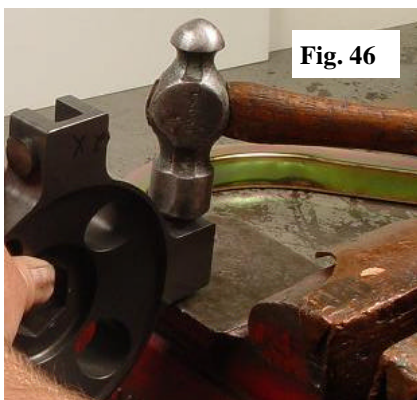
After all four positions fit individually spider should slide easily in tower, if not remove shims at tight buttons until spider fits free in tower.

On BLACK SPIDERS built from 2000 to 2003 when you replace buttons you will need to measure and fit each button. All Polaris buttons should measure .245 thick when new, fig 47.

All 8 buttons must be sanded to .242 to .243 before installing in spider, fig 48.

Be sure buttons are fully installed in spider with metal hammer on solid surface, fig 46.

Next check fit in tower, should be .001 to .003 clearance. This procedure will not be necessary on next build of spiders.



Replacing Bearings

Cover bearing should be replaced when clearance is over .010. Normal used bearing will measure 1.255 with wear limit 1.260". Use hacksaw to split bearing, be careful not to cut into aluminum, fig 49.

Next clean and install new bearing then flair ends with ball peen hammer, fig 50.

Moveable bearing should be replaced when clearance is over .015. Normal used bearing will measure 1.618 with wear limit 1.625". Remove circlip then check size of bore. If bore is smaller than 1.875" install moveable in lathe and remachine to size then remove bearing. Next clean bore and check entire length of bore measures 1.875" and the circlip groove is open to accept new circlip and there is at least .020 aluminum to hold in circlip, remachine as needed or replace moveable pulley asm. If bore is worn larger than 1.875" an oversize bearing can be installed. Remachine bore to 1.900" then install PN 700-7136 bearing. Always use press to assure bearing goes in straight and is not damaged, DO NOT HAMMER IN. Always install new circlip.

All rebuilding procedures must be done by an experienced technician or return clutch to HRP.

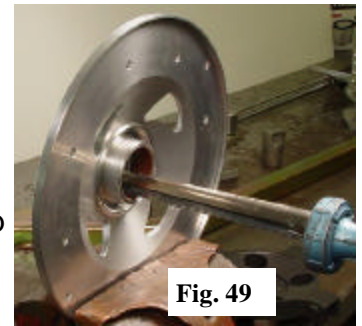


Fig. 49

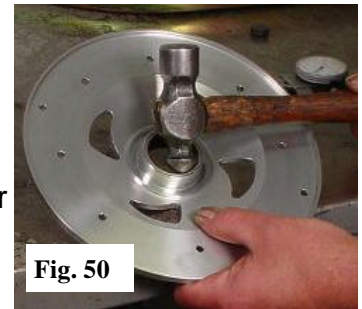


Fig. 50

DRIVEN CLUTCH and CHASSIS SETUP

Quad Cams are 8.2" diameter and will work with any driven clutches that we know of. If you are using a standard 10.75" driven clutch from Arctic Cat, Ski-Doo or Yamaha there are no changes required to driven. If you are using a Polaris driven you may want to modify the helix to allow the clutch to open wider for optimum performance.

If you are using Arctic Cat bearcat 11.5" driven you must use correct belt and different gearing but Quad Cam works well with this driven. If you will use the 1 7/16" wide belt be sure Quad Cam is setup for the wider belt. Contact HRP for details.

Due to so many different drivens and aftermarket helix cams being sold for all brands it is difficult to detail modifications that may be required for each combination of parts. The following procedure explains how to easily check if driven size, opening, center distance and belt length match to Quad Cam.

1) Assemble driven with helix you want to use, remember tension and angle discussion in tuning info. Set driven neutral opening so .560 thick belt is flush to outer diameter of pulley, fig 51.



Fig. 51

Set opening for .600 thick top cog belt to ride out of pulley 1/16", fig 52.

Set preload on torsion spring drivens by using vice grip or similar tool to attach scale to moveable pulley. Next measure how many pounds it takes to begin opening driven. Driven must be clean and have light oiling at center washer before measuring. Most drivens are still set this way except electric reverse or Team driven.

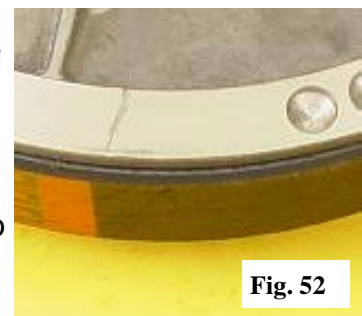
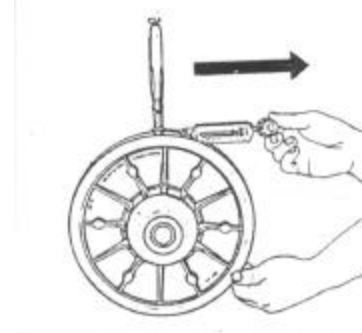


Fig. 52

RECOMENDED PRELOAD

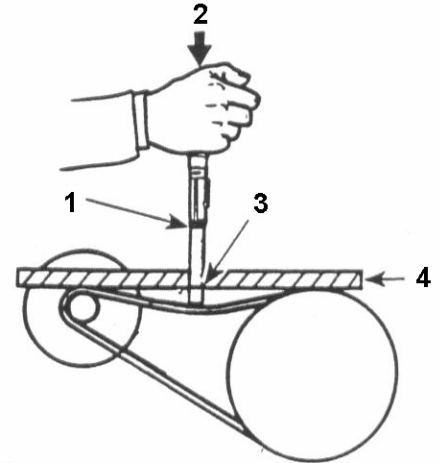
60 to 100 hp = 10 to 15 lb	100 to 150 hp = 15 to 20 lb
150 to 200 hp = 20 to 25 lb	200 to 250 hp = 25 lb min



DRIVEN CLUTCH and CHASSIS SETUP cont.

2) Set center crankshaft to center countershaft distance and alignment. Use specifications for alignment on page 25 along with center distance for your machine which you must know or get from factory specs. If you are just replacing drive clutch in stock machine the setup should be fairly close and not require adjustment. If you are building machine you must measure and set these dimensions accurately. If you do not know center distance you can measure the belt and figure center distance, see chart page 26.

3) Set belt deflection. If centers and belt match the belt deflection should measure per illustration below. Reset driven neutral opening to adjust for small variations in belt length or center distance. Having the belt down inside or riding out of pulley 1/8" to get correct deflection is ok. For vehicles with wheels you may want slightly looser belt to stop machine moving at idle.

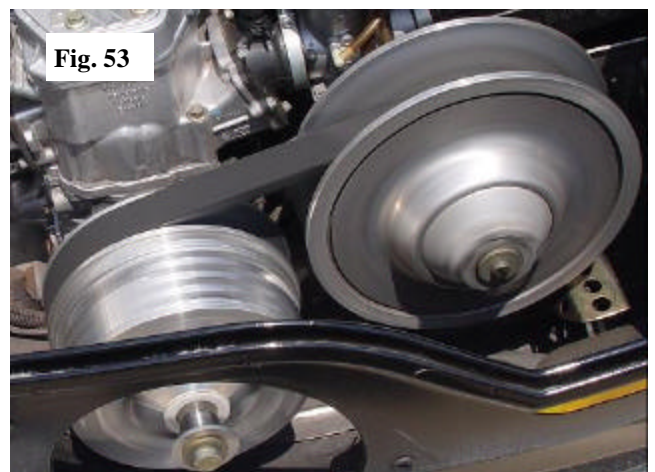


- 1) Belt tension gauge
- 2) Push to 15lb load on belt
- 3) Measure from belt to bar, 10" centers = 7/8"
12" centers = 1.0"
- 4) Straight edge on top of belt

4) Test on stand. Use secure jack stand and test run the setup, check neutral and set engagement. While running track slowly with belt guard removed check drive and driven runout, there should be nearly zero visible runout at pulleys. Replace belt guard then carefully rev machine to check shift. Be sure to use good stand and you have at least 5" clearance from track to ground. Increase speed slowly, track should run smoothly to 100 mph. If machine starts to bounce up and down violently at rear slow down track immediately. If this happens the track is out of balance due to missing studs or cords are broken inside track, replace studs or track before running at high speed on stand or on ground.

5) Setting Full Shift Belt Position If everything checks ok we can now test full shift belt position. Remove spring from Quad Cam and reassemble cover then reinstall on machine to run without spring. With machine on stand start engine and slowly increase rpm until belt stops rising in drive pulley, fig 53.

It should only take about 1/4 throttle to make belt rise completely. Belt may come out of Quad Cam slightly or may stop rising down inside pulley. Best setting is when driven stops opening the belt is down inside Quad Cam about 1/16". You can visibly see belt position or use marker on pulley and see where belt rides.



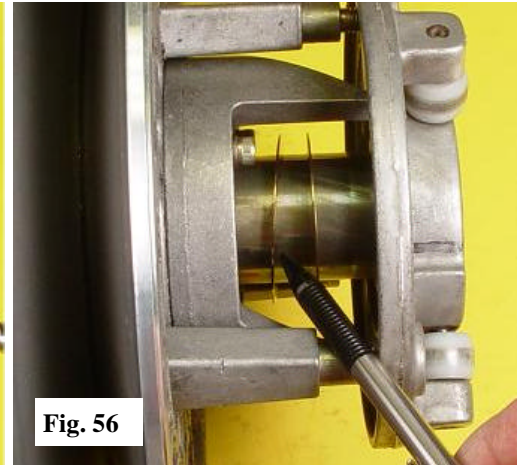
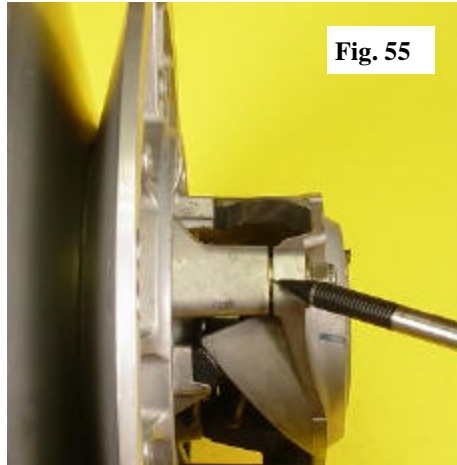
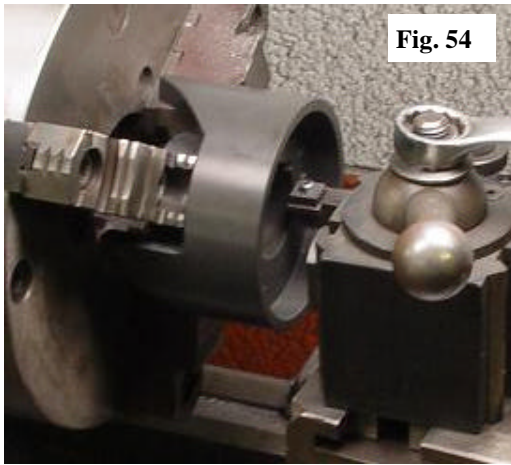
DRIVEN CLUTCH and CHASSIS SETUP cont.

On Polaris and ski-doo style driven you can adjust driven open position by removing material from helix under circlip washer, fig 54 which will allow belt to rise in drive pulley or add washers under circlip to lower belt in drive pulley. Changing .030 at driven opening will move belt position about 1/16" in drive pulley.

NOTE : Always use at least one washer under circlip.

On cat or Yamaha driven you can add shim washers under button cover to allow belt to rise in drive pulley, fig 55 or use Polaris driven washers on shaft under button cover to lower belt in drive, fig 56.

Adjusting full shift belt position on machines with 200+ hp is especially important. Proper belt position will maintain tension and grip on belt at high speed which prevents slipping and overheating the belt. It is also important to have proper gear ratio to prevent clutch reaching full shift too quickly.



DRIVEN CLUTCH and CHASSIS SETUP cont.

6) Gear Ratio Setting

If you are installing Quad Cam on a factory built snowmobile for general snowmobiling use the stock gearing to start out. If you are building a machine or modifying for drag racing, you need to know what the top speed potential is for your machine at the distance of the racetrack. Install gears that are at or slightly higher mph than your speed potential and start testing and tuning the clutch setup. After you have a good clutch setup, if your max mph in testing is slower than the ratios you selected you may benefit from a slower mph ratio. If you are running at or more mph than the ratios you selected you may benefit from a higher mph ratio. Always get the clutch setup close before changing gears and change the ratio 5 to 10 mph to see a difference, normally one tooth at small sprocket. Again test and tuning is the key, changing the gear ratios directly effects the clutch setup and fine tuning both in combination will yield best performance.

This ratio to mph formula can be used for all types of machines. You must know the peak horsepower rpm of your engine to make accurate calculation.

First figure the speed ratio for your machine based on the size of the track sprocket or tire size.

$\text{Sprocket or tire circumference times 60 divided by 63360} = \text{speed ratio}$

Example; 9 tooth sprocket X 2.52" pitch of teeth = 22.68" circumference,
 $22.68 \text{ times } 60 \text{ divided by } 63360 = .021 \text{ speed ratio}$

Engine rpm (9000) times small sprocket (20) divided by large sprocket (40) times speed ratio (.021) = 94.5 mph at 1 to 1 clutch ratio.

For Quad Cam with standard 10.75" driven we figure 10% overdrive so add 10% to engine rpm. 9900 times 20 divided by 40 times .021 = 104 mph. This is the calculated speed for this machine at full shift of Quad Cam clutch.

For Quad Cam with Bearcat 11.5" driven do not add 10% overdrive to engine rpm, use 1 to 1 ratio.

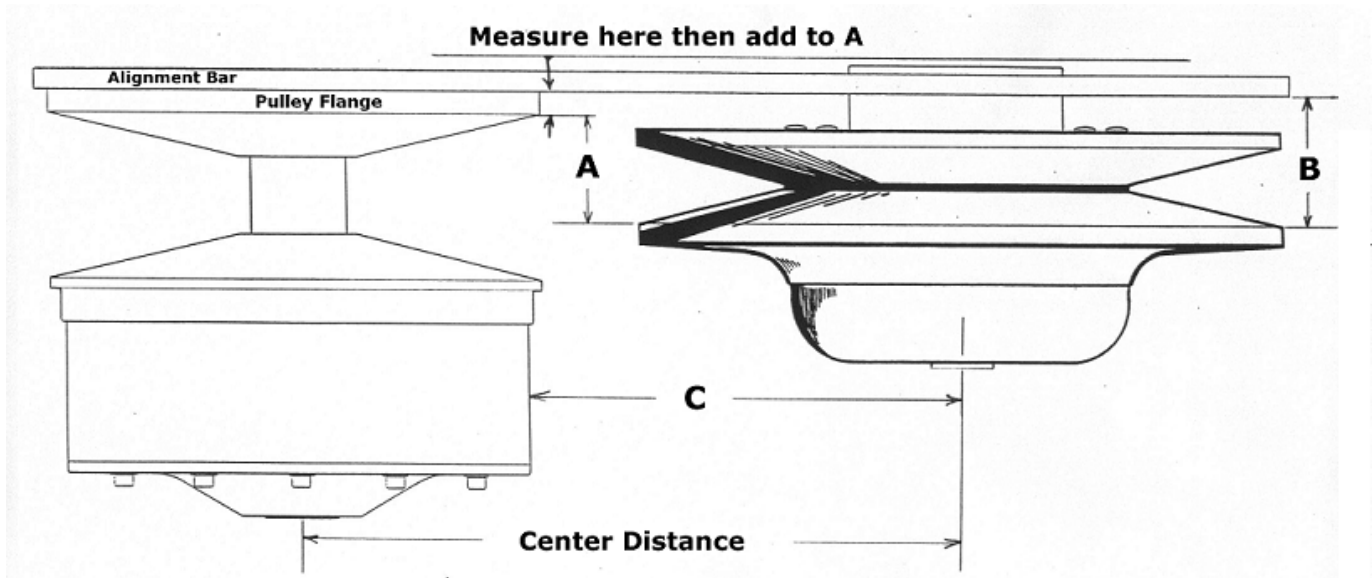
TIRE Example; with 72" circumference tire times 60 divided by 63360 = .068 speed ratio
 $9000 \text{ plus } 10\% = 9900 \text{ times } 12 \text{ divided by } 72 \text{ times } .068 = 112 \text{ mph calculated speed at full shift.}$

These examples are calculated speeds only. The calculated speed must match the speed potential. If you install gears for 140 mph calculated speed and you have 100hp you will never get belt to full shift. If your machine will not shift out the clutch and reach the speed first be sure engine is running properly. Next work on clutch setup to allow engine to hold maximum rpm through the shift range. After you are sure of overall setup you may not be able to achieve the desired speed in the distance you race and could try slower mph gear to improve acceleration.

A typical performance gauge for many tuners is if the belt is coming to the top of the drive clutch. The only time the belt should be at full shift is when machine is at top speed. Most snowmobiles are never run in conditions where they can reach their calculated top speed but if your on hard pack snow and have flat, one mile straightaway this is where factory sets gear ratios on high performance sleds and most will reach full shift in this condition. Changing to slower top speed ratio will decrease top speed and may not improve acceleration due to traction limitations. Again test and tune but have some way to judge if its better, side by side with another machine is usually best.

If your machine goes to full shift too quickly Quad Cam will show heavy contact at base of pulleys at shaft and usually leave black ring at top of pulley from belt slip, also engine may overrev at top speed. Add 1 or 2 teeth to small sprocket and retest. Usually having calculated speed 5 to 10 mph higher than speed potential of machine will give best performance.

Offset and Alignment Specifications



DRIVE TYPE = QUAD CAM Any year or pulley modifications.

BELT = 1 3/8 inch top width ONLY.

OFFSET
A= Measure from drive to driven at outer edge of pulleys. **Add thickness of drive pulley flange then add to A if measuring to alignment bar.**

DRIVEN TYPE =	Cat, Polaris, Yamaha, Team	A= 1.82" + flange	+/- .040 "
	Ski-Doo	A= 1.77" + flange	+/- .040 "

ALIGNMENT B=	Subtract from A+ pulley flange to allow for engine movement and shaft flex.
	Rubber engine mounts = .040 to .060 inch less than A
	Solid engine mounts = .020 to .040 inch less than A

CENTER DISTANCE tolerance +/- .060	You must know factory center distance or use chart below as reference. Subtract 3.85" from center distance for C to easily measure with clutch installed
---------------------------------------	---

FOR WIDER BELTS Add the width difference from 1.375 belt to OFFSET A dimension.

METRIC DIMENSIONS Inches X 25.4 = Millimeters

PULLEY FLANGE THICKNESS is different depending on year and machining.

Offset A measurements are from belt surface to belt surface allowing pulley flange thickness to change with cover or starter gear installed.

PROCEDURE

1) Set offset A by adjusting offset washers on countershaft. (on shaft before driven) Be sure driven is pushed tight to offset washers when measuring and you have proper clearance from helix to frame or bearing bolts. If necessary add offset washers for clearance then readjust engine position to set offset A. **DO NOT MACHINE HELIX CAM FOR CLEARANCE.**

2) Set alignment B and center distance C by moving engine in adjustable mounts. When finished all dimensions A, B and C must be within specifications all dimensions.

BELT LENGTH TO CENTER DISTANCE

These examples are popular standard dimensions for many models of the brand. By measuring a factory replacement belt for your machine you can figure your center distance.

Examples are for 1 3/8 X .560" thick flat top belts. If you are using Top Cog or flat top belt that measures .600 to .625 thick the belt would be about 3/8" longer for same centers.

Use 1/4" wide steel tape to measure outside belt length and calipers for thickness.

Polaris belt	47 1/4 X .56 = 12.0" center	OR	47 5/8 X .60 = 12.0" center
Cat & Ski-Doo	43 1/2 X .56 = 10.2" center	OR	43 7/8 X .60 = 10.2" center
Yamaha	44 1/8 X .56 = 10.5" center	OR	44 1/2 X .60 = 10.5" center

If belt length changes 1.0" the center distance will change 1/2". So if you have 48 5/8 X .60" belt you would use 12.5" center distance.

For Bearcat 11.5" driven add 1.5" to belt length for same centers.

TERMS AND WARRANTY AGREEMENT

Minimum Order

\$25.00 minimum purchase without shipping charges is required.

Phone Orders

Phone orders received before noon Eastern Standard Time will usually be shipped via UPS within 24 hours.

Payment-U.S. Customers

All orders are shipped C.O.D. Certified Check or Money Order or prepaid VISA, MasterCard. Charge cards can be used for up to \$250.00 only. Purchases over \$250.00 must be C.O.D. Certified Check or M.O. or prepaid by mail.

Payment-Canadian Customers

All orders under \$250.00 must be prepaid on charge card. Orders over \$250.00 must be prepaid with M.O. or Bank Check prior to shipping goods. There are No C.O.D. deliveries in Canada. All payments US Funds.

Shipping

All orders are shipped by UPS unless alternative carriers are required. Regular UPS and air service available.

Returns/Refusals

Items can be returned on an individual basis and require approval from HRP. If HRP ships wrong item HRP will issue package pickup notice and pay shipping both ways to correct problem. All returns must be approved by phone call prior to sending back item. Returns may be subject to 15% restocking fee. Returned items must be in new, unused condition, in original package and must be returned within 10 days of receipt.

Dealers

All dealers must have a Dealer number to order and receive dealer pricing. Applications can be obtained by phone request to: HRP Motorsports Inc. Full time store owners only.

Prices

All prices for products are F.O.B. HRP Motorsports, Inc., 8775 Belding Road, Rockford, Michigan 49341. Prices are subject to change without notice.

Hold Harmless and Warranty Disclaimer Agreement

Purchasers (herein referred to as customers) of products or services from HRP Motorsports, Inc. understand and recognize that snowmobiling, off road vehicle operation or racing is dangerous and customer accepts all risks involved in these activities.

HRP Motorsports, Inc. (herein referred to as a company) prepares its products and services to the highest standards possible and has determined the condition of vehicle or parts to be properly assembled prior to sale or return to customer unless noted in writing. Customer must inspect and test vehicle or parts and be satisfied that they are in safe and proper condition prior to use. Customer understands that there are risks of mechanical failure in any vehicle and that is impossible, regardless of cost, to eliminate this risk in off road vehicles.

Customer understands and recognizes that off road vehicles, parts, equipment and services prepared by company are exposed to many varied and uncontrolled conditions during use. Company makes no warranties whatsoever, expressed or implied, oral or written, to customer as to serviceability or merchantability of products. Parts and vehicles are sold in "as is condition" and are accepted by customer with this knowledge. Customer has complete opportunity to examine vehicle or parts and accept them in as is condition, or, prior to any use, may return them with written explanation as to why product does not meet customer expectations.

As consideration for customers using company parts and services, customer acknowledges that due to differing conditions and circumstances under which vehicles and products are used-customer is not relying on company skill or judgment to select or furnish proper parts or equipment. Customer expressly affirms that they are relying upon their own skill and judgment to select or purchase suitable goods and have examined and accepted those goods by customers own judgment.

Due to uncontrolled circumstances arising during off road operation or any activity involving operation of company prepared vehicles, parts or services, customer agrees to "Hold Harmless" company. Company is not responsible for any damages resulting from injury or death resulting from accidents while company prepared vehicles or parts are in use regardless of reason for accident.

This "Hold Harmless" agreement includes release from all liabilities resulting from use of company products or services and that no lawsuits will be brought against the company for damages or otherwise.

Customer understands and agrees that no officer, director, employee of company or outside sales agent has any authority to make any statements contrary to the terms of this agreement. Furthermore, company disavows any statement contrary to this agreement.

Contact Information:

**HRP Motorsports Inc.
8775 Belding Rd.
Rockford, MI 49341**

**Phone: 616-874-6338
Fax: 616-874-8500
Email: brad@hrpmotorsports.biz**

Brad Hulings, President.

Polaris Weight Arms

HRP stocks all the Polaris weight arms shown on chart. Arms are sold each and are weighed then matched +/- .3 grams.

Polaris Weight Arm Chart

<u>Part No</u>	<u>Arm ID</u>	<u>Tip</u>	<u>Grams</u>
5630101	Z	Full	29.5
5630148	T	Full	32.8
5630145	L	Full	34.2
5630147	R	Full	36
5630146	Q	Full	38
5630144	K	Full	40
5630089	P	Full	42
5630065	J	Full	44
1321530	10MR	Mod	43.5
5630301	M	Mod	46
1321527	10/46	Mod	46
5630068	M	Full	47
1321529	10MB	Mod	47
1321528	10M5	Mod	49
5630064	H	Full	50
1321526	10	Mod	51
1321531	10AL	Mod	53
5630080	N	Full	53.5
5630234	O5	Mod	53.5
1321589	10A	Mod	54
5630274	15	Mod	55.5
1321588	10/58	Mod	58.5
1321587	10/60	Mod	60.5
1321586	10/62	Mod	62.5
1321585	10/64	Mod	64.5
1321584	10/66	Mod	66.5



Mod Tip



Full Tip

Full Tip arms work well for high RPM highly modified engines used in drag racing.
 Mod Tip arms most common arms used on all larger displacement engines.
 The 10 series arms offer a wide range of grams selection and work well for trial or racing.

Clutch Spring Chart

HRP stocks a wide selection of springs to fit Quad Cam. The following drive clutch spring chart shows the number of pounds pressure the spring exerts at engagement (2.50") to full shift (1.19"). This chart shows HRP and Polaris springs allowing the tuner to select the proper range of springs based on his needs. Higher pressure spring equals higher RPM while lower pressure equals lower RPM. Changing 50 lb. spring pressure changes about 500 RPM.

<u>Part No</u>	<u>Pounds at 2.50"</u>	<u>Pounds at 1.19"</u>	<u>Color</u>
7041060	70	200	Orange
7041063	75	140	Purple
7041062	75	275	Silver
7041150	100	220	Red/White
7041148	100	275	Gold
7041065	117	200	Pink
7041083	120	240	Red
7041080	120	290	Blue *
7041781	120	310	Blue/White
7042083	120	340	Black/Green
500-1210	120	360	Gray *
7041818	140	320	Black/White
7041645	150	290	Almond/Gold
7041922	150	310	Almond/Blue
500-1211	150	400	Violet *
7041988	165	310	Almond/Red
500-1207	170	325	Orange/Black



* Designates most popular springs used by HRP for most machines.

500-2117 HRP Gray Driven Spring

Wound from .207 wire with 3.30 " free length this spring allows driven to open easily at start with increased grip on belt at high speed compared to Polaris blue.



HRP BLACK ICE Helix Cams

Current Sizes Available as of 6/1/03

POLARIS Black Ice size on helix

<u>Straight Angle</u>	<u>Progressive</u>	<u>Progressive</u>	<u>Hole Shot</u>
30 *	34/30 *	44/34	41/36
32	36/30	44/40	45/36
34 *	36/32 *		45/40
36 *	38/32	46/40	49/36
38 *	38/34 *	46/42 *	49/40
40 *	40/30	48/38	
42 *	40/34 *	48/44	
44	40/36 *	50/44 *	
46	42/36 *	52/42 *	
48	42/38 *		
50			



SKI-DOO Black Ice size on helix

<u>Straight Angle</u>	<u>Progressive</u>	<u>Progressive</u>	<u>Hole Shot</u>
32	36/32	46/40 *	43/40
	38/32 *	48/44 *	45/42
38		50/40 *	47/40
40	40/36	50/44 *	47/44
42	42/36	50/46 *	49/46 *
44	44/34	52/46 *	51/40 *
46 *	44/36 *	52/48 *	51/44 *
48 *	44/38	54/44 *	51/46 *
50 *	44/40	54/48 *	55/44 *
52 *			
56 *			



Add 4 Degrees to Black Ice sizes to match Ski-Doo factory angles.

Black Ice Coating will also effect RPM in some cases. Due to less friction clutch shifts faster and you may want to use 2 to 4 degrees less than with noncoated helix OR adjust engine clutch as needed.

All sizes marked with * are clearance priced, call for details.

RETURNS or EXCHANGES Only NEW never used may be returned or exchanged.
NO RETURNS IF SOLD AT CLERANCE PRICE.