PARTS LIST

- #1 PISTON
  - CREATES PRESSURE, VACUUM, & ABSORBS POWER

HERE IS WHAT YOURS IS GOING TO LOOK LIKE OUT OF YOUR ENGINE

PISTONS

YOURS

PARTS LIST

- #2 CYLINDER
  - GUIDES THE PISTON

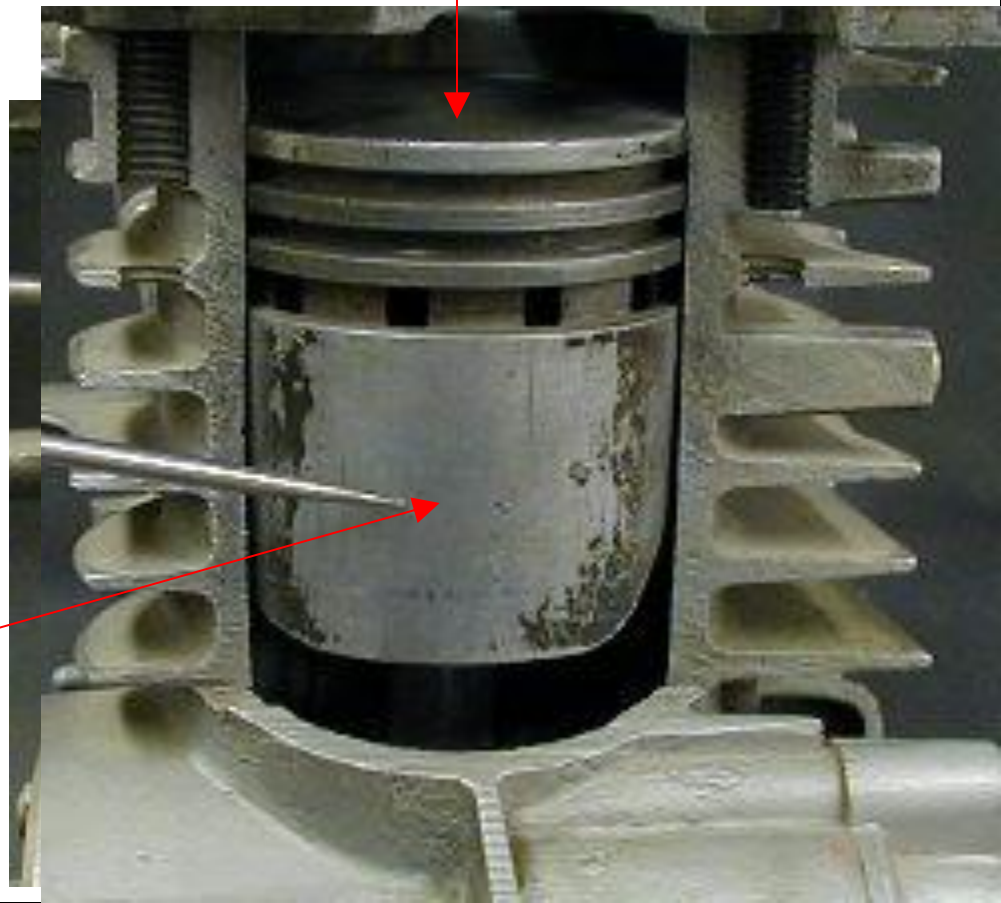
THIS CYLINDER IS REMOVABLE OUT OF THE ENGINE. IT IS CALLED A SLEEVE

THIS ONE IS OUT OF JOHN FORCE'S FUNNY CAR! WE GOT IT ON ONE OF OUR AUTO CLUB TRIPS IN SEATTLE.

CYLINDERS

SLEEVE

PART OF BLOCK



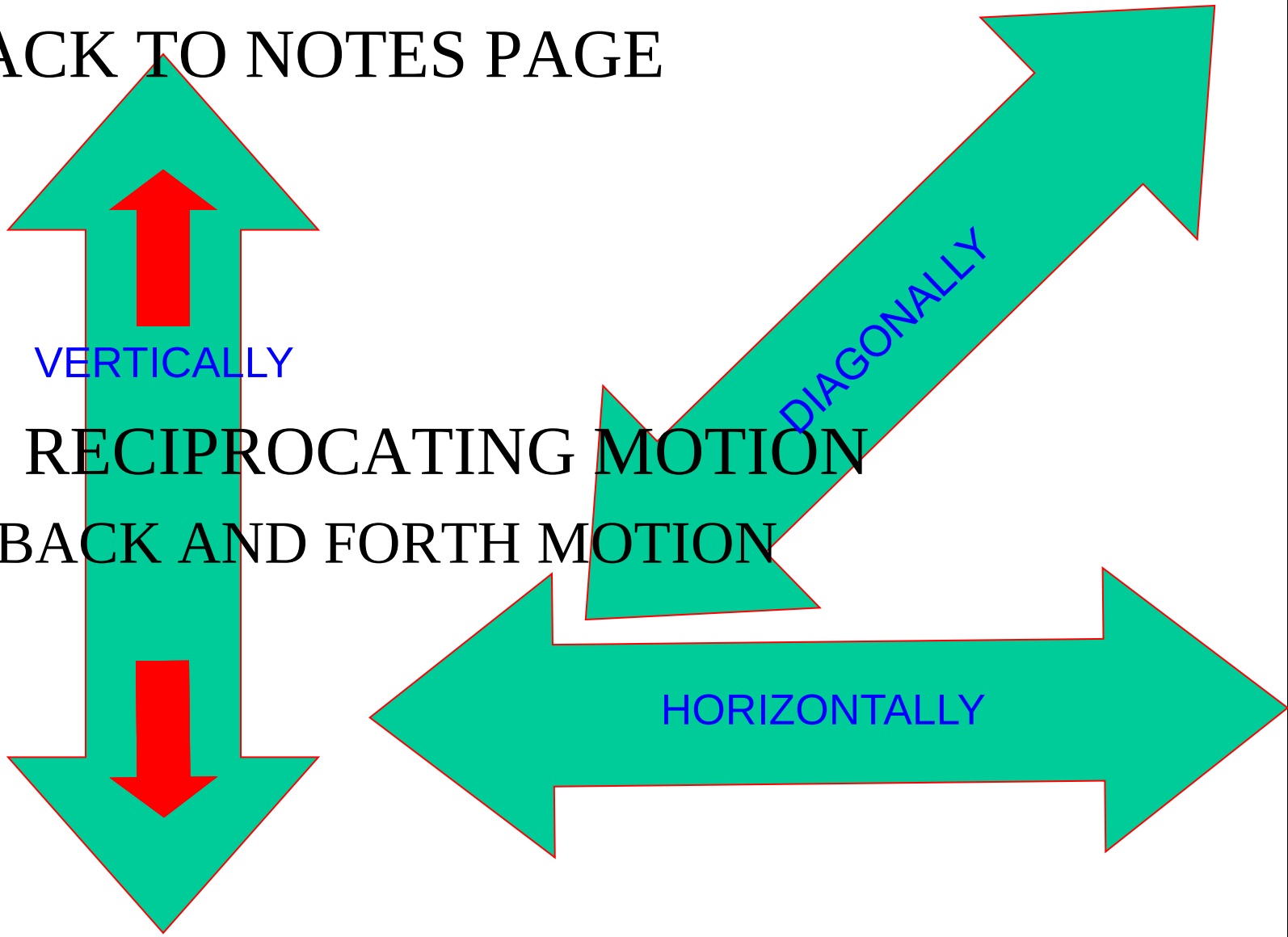
CYLINDER GUIDING PISTON

PISTON AND CYLINDER

- CLEARANCE
  - ROOM IN BETWEEN THEM
  - APPROXIMATELY .002” TO .003” TOTAL
    - .001” TO .0015” ON EACH SIDE
- TOO MUCH?
- TOO LITTLE?

ENGINE NOTES

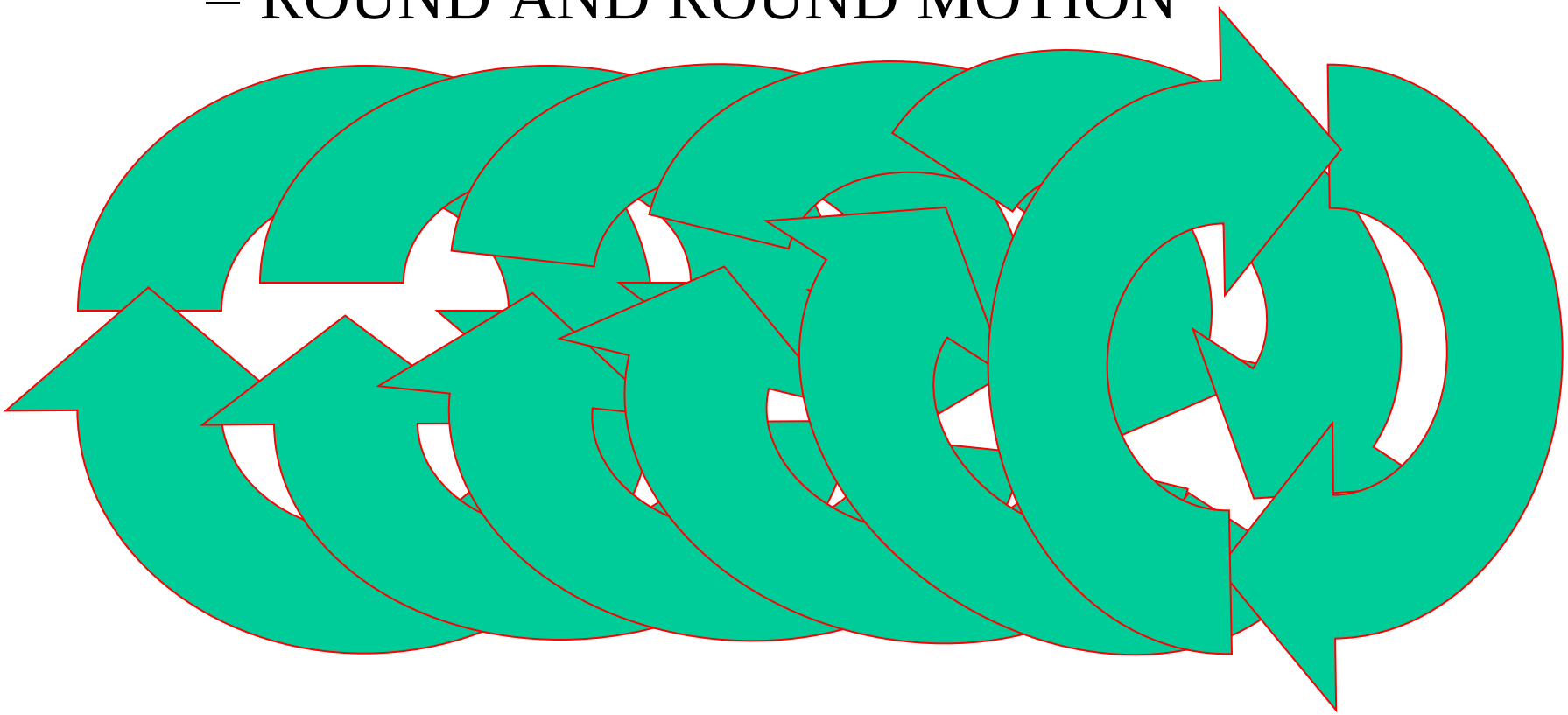
- BACK TO NOTES PAGE



- #4 RECIPROCATING MOTION
  - BACK AND FORTH MOTION

ENGINE NOTES

- #5 ROTARY MOTION
  - ROUND AND ROUND MOTION



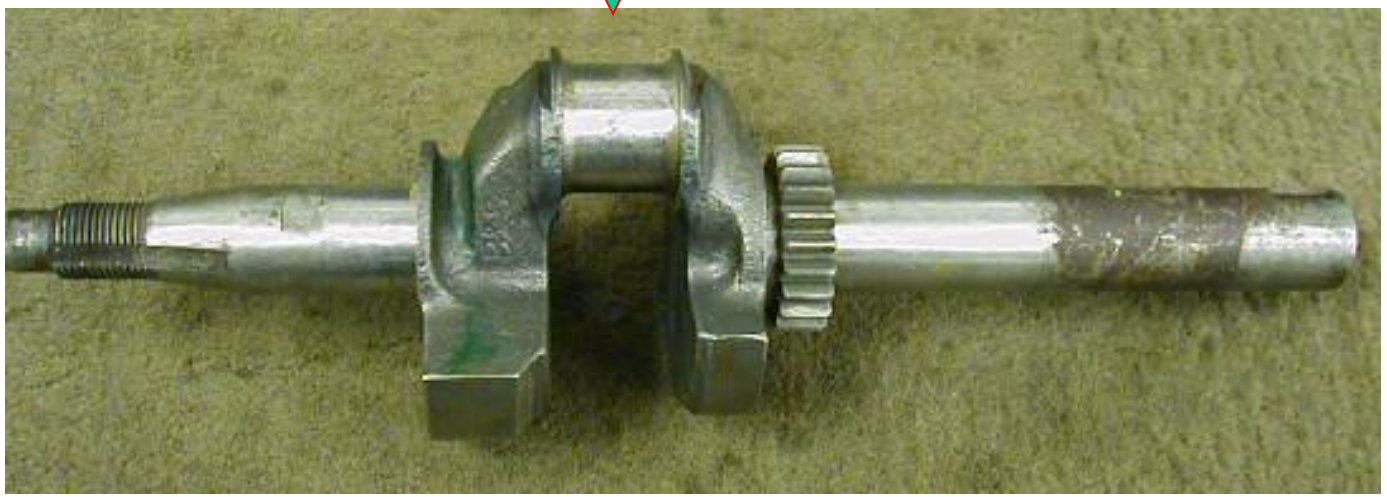
BACK TO PART #3

- #3 CRANKSHAFT
  - A. TURNS RECIPROCATING MOTION INTO ROTARY MOTION
  - B. CONNECT TO, TO GET POWER FROM ENGINE
  - C. TURNS (DRIVES) THE CAMSHAFT

CRANKSHAFT

NOTICE THE OFFSET ARM

THIS IS CALLED THE CRANK ARM
OR CRANK PIN



HERE IS WHAT YOURS WILL LOOK LIKE.

PARTS LIST

- #4 CONNECTING ROD . .
  - •CONNECTS THE PISTON TO THE CRANKSHAFT

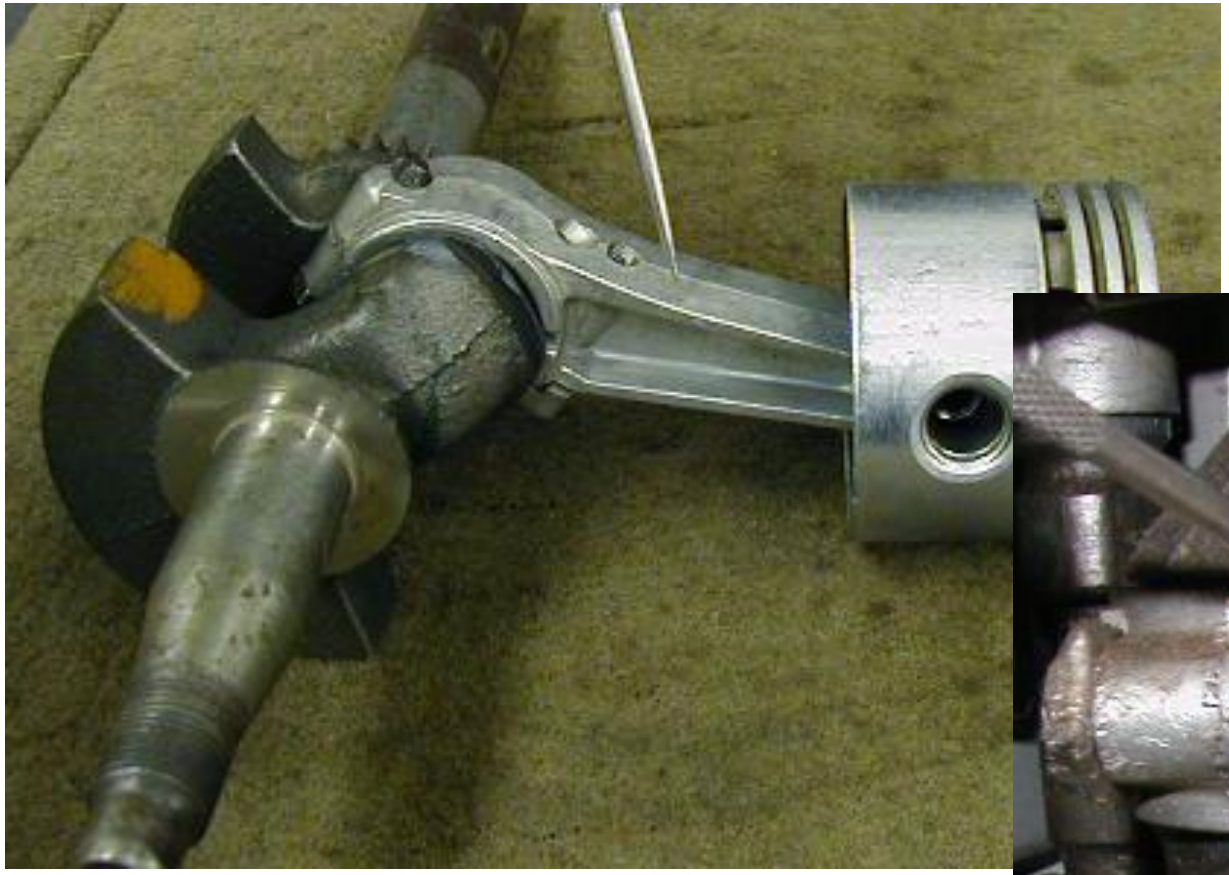
THESE ARE WHAT YOURS WILL LOOK LIKE

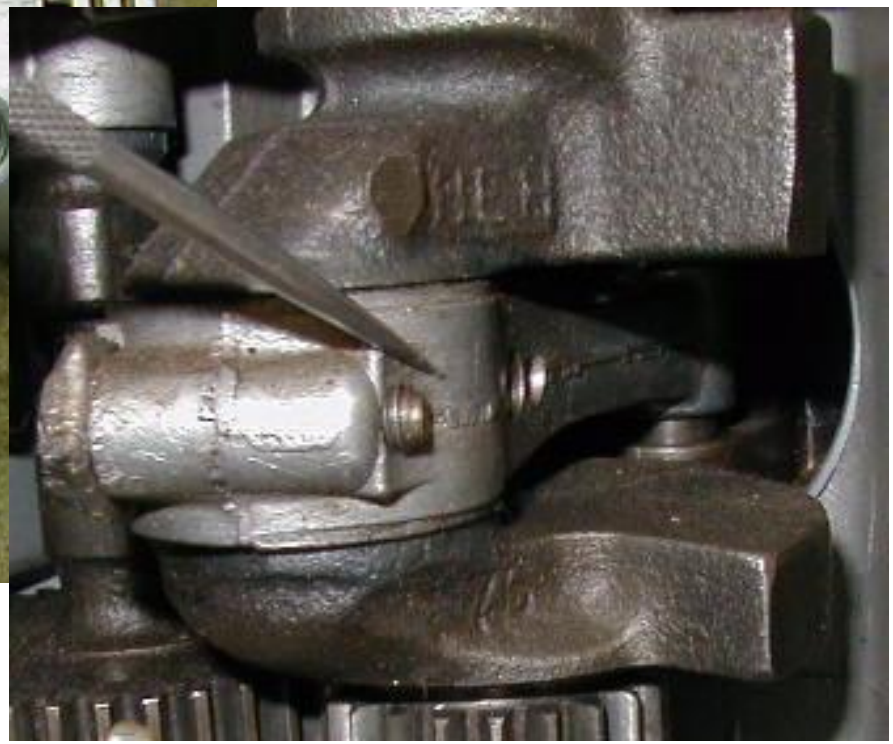
CONNECTING RODS

LITTLE END HOOKS TO THE PISTON

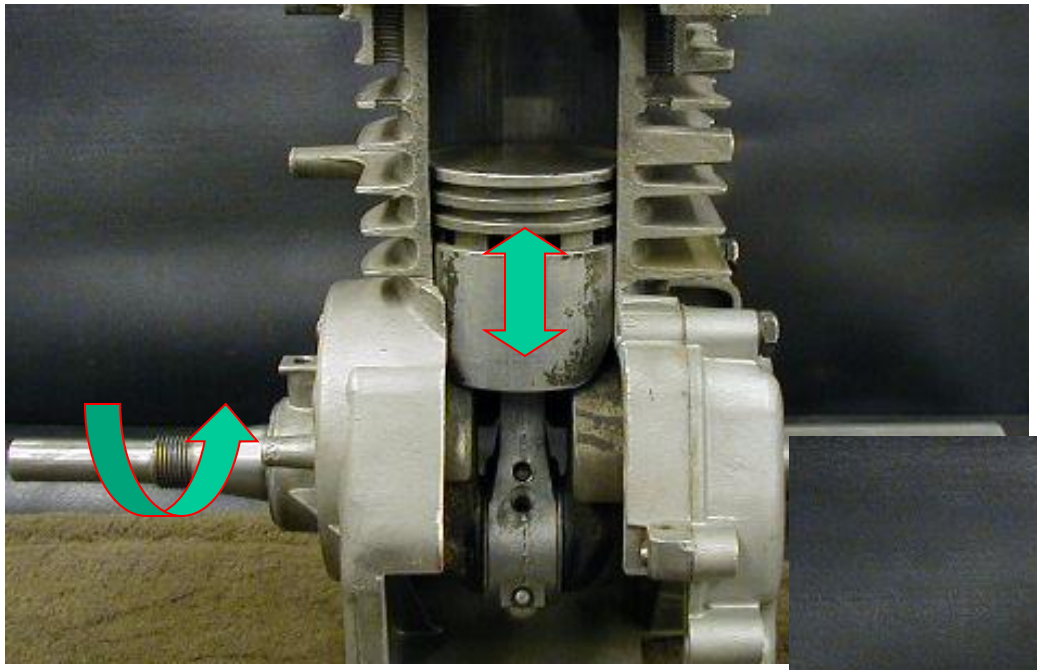
BIG END HOOKS UP TO THE CRANK PIN ON THE CRANKSHAFT

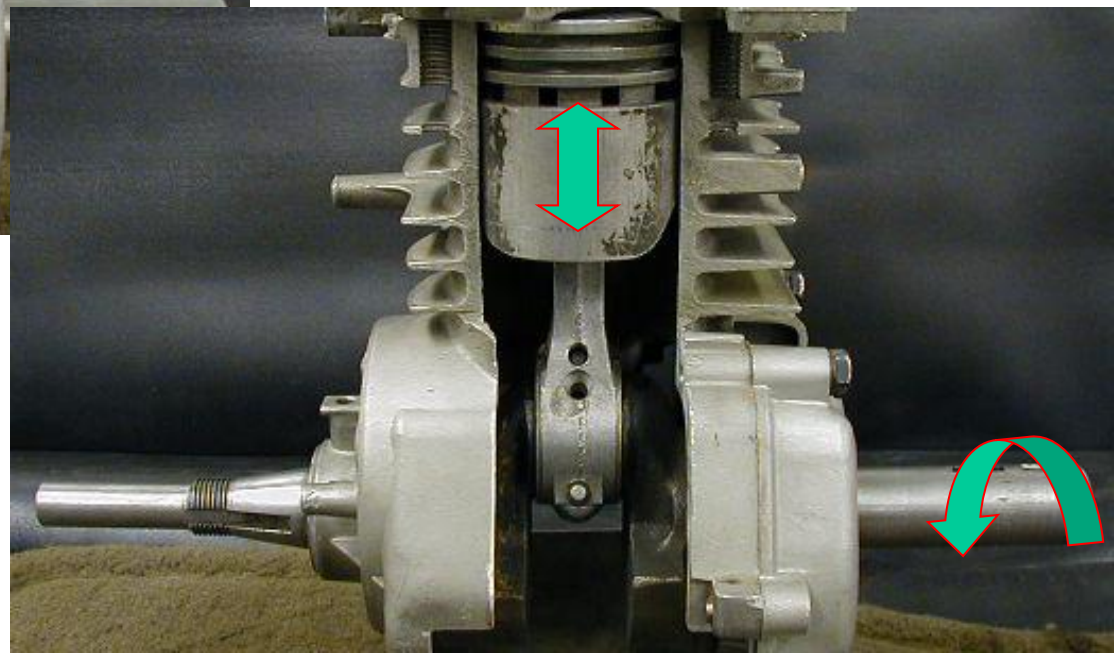
PISTON, CONNECTING ROD & CRANKSHAFT



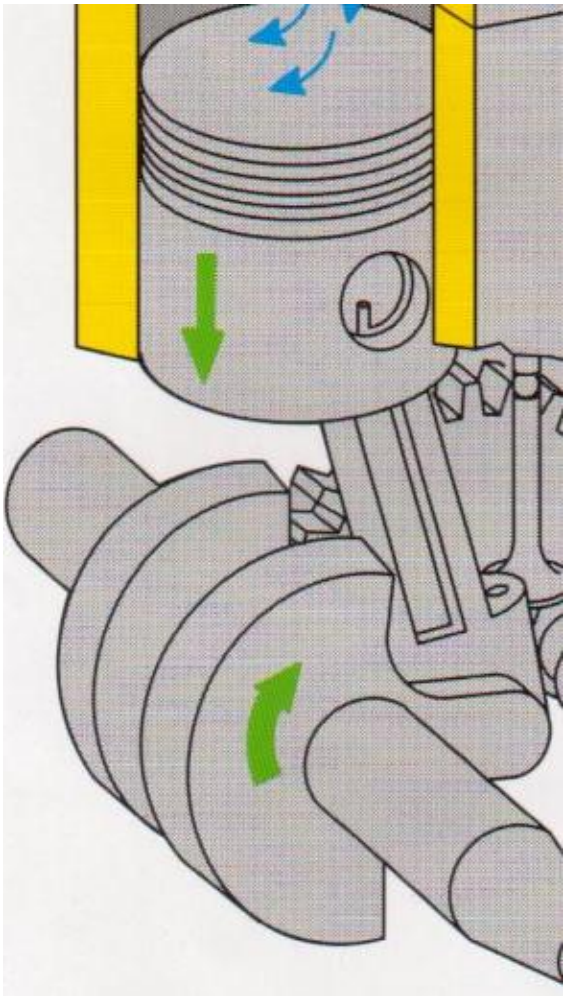


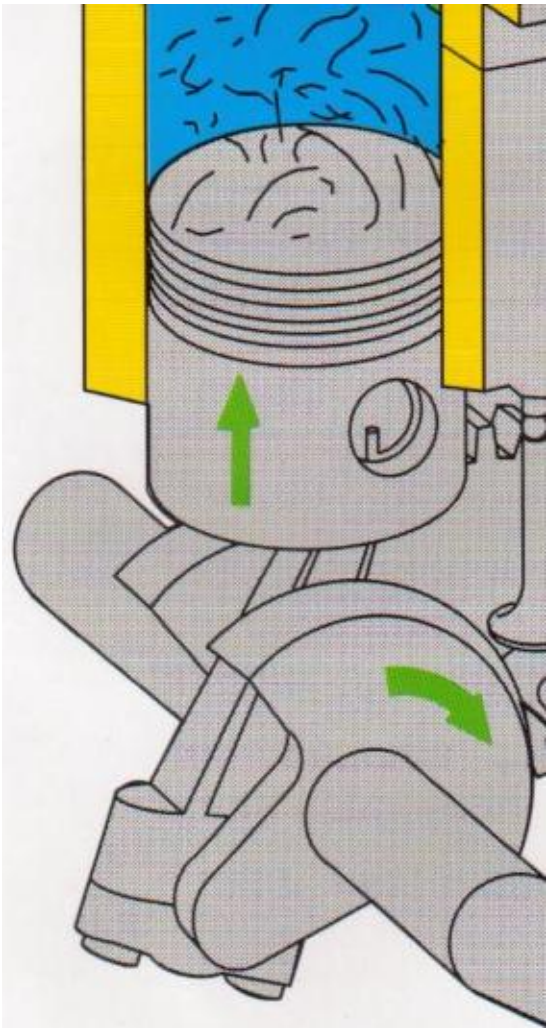
CRANKSHAFT, CYLINDER, PISTON, & CONNECTING ROD

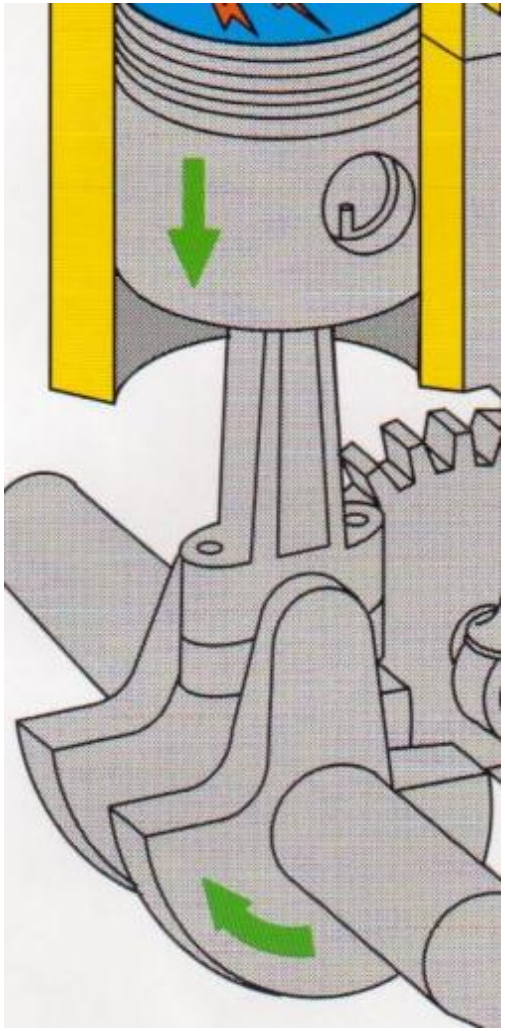




PISTON RECIPROCATING BACK AND FORTH



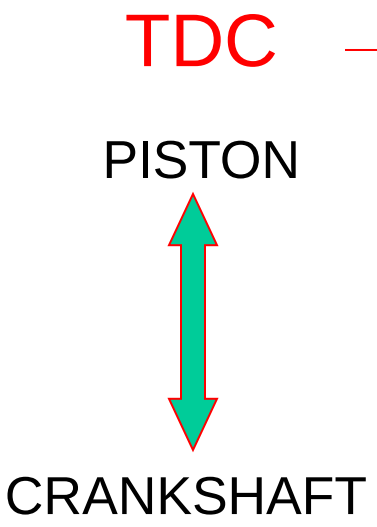


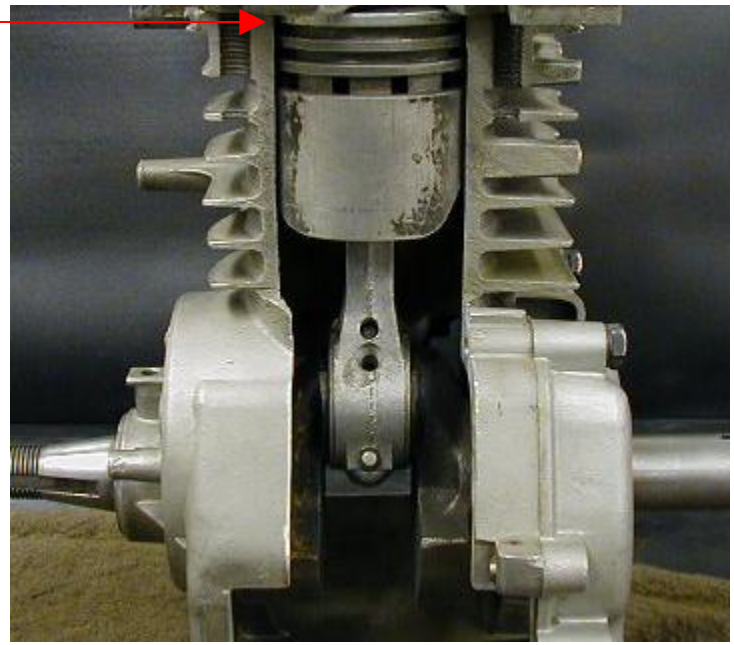


CRANKSHAFT ROTATING AROUND AND ROUND

ENGINE NOTES

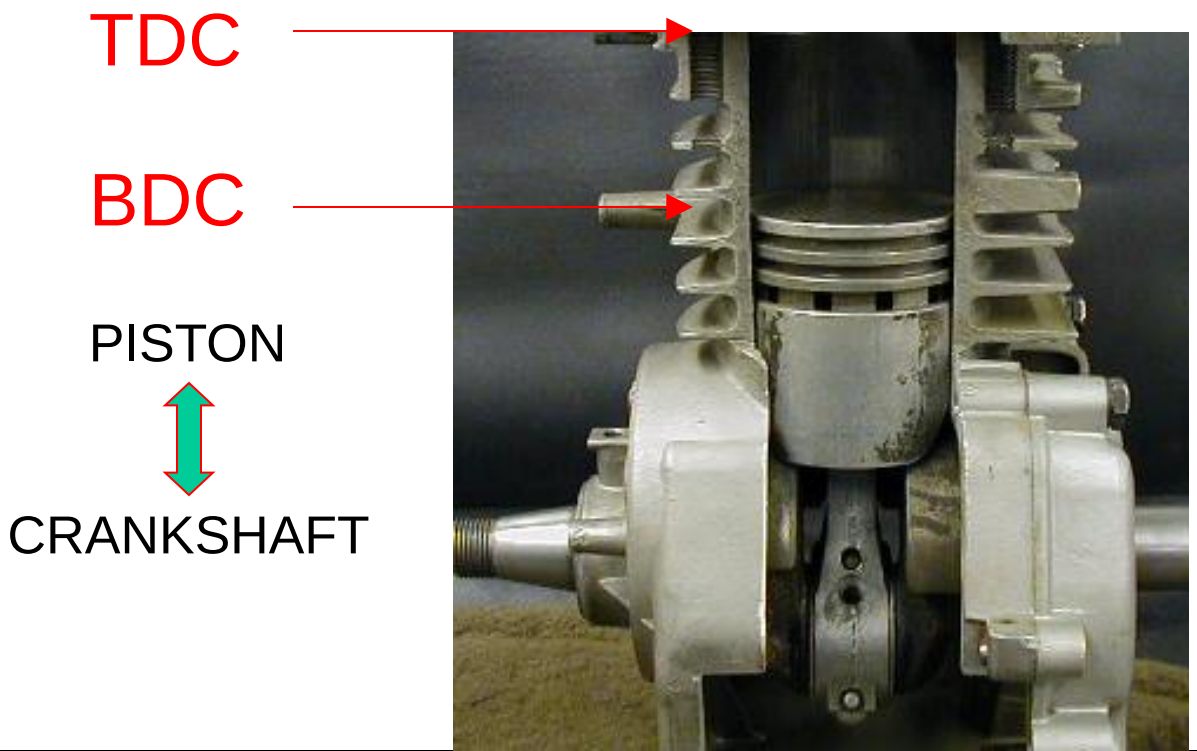
- LETS GO BACK TO OUR NOTE PAGE
- #6 TDC
  - TOP DEAD CENTER, PISTON FURTHEST FROM CRANKSHAFT





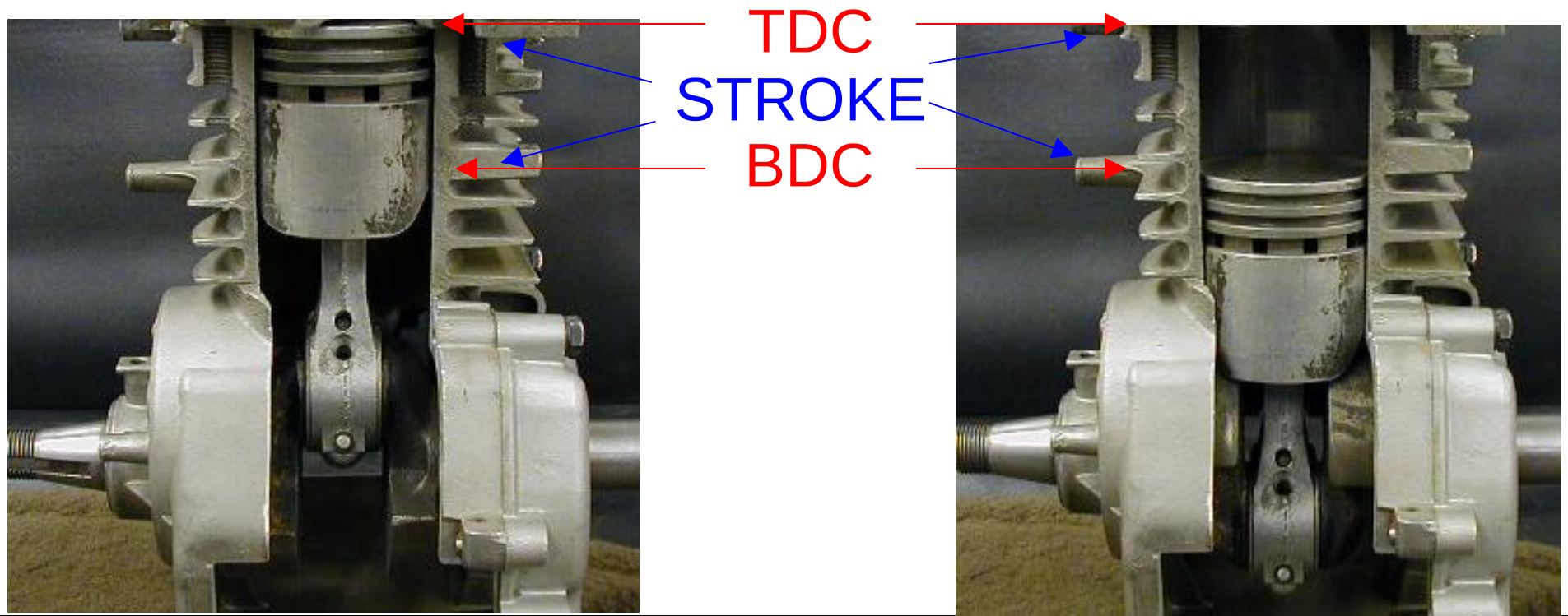
ENGINE NOTES

- #7 BDC
  - BOTTOM DEAD CENTER, PISTON CLOSEST TO CRANK



ENGINE NOTES

- #8 STROKE
  - DISTANCE THE PISTON MOVES FROM TDC TO BDC OR BDC TO TDC



ENGINE NOTES

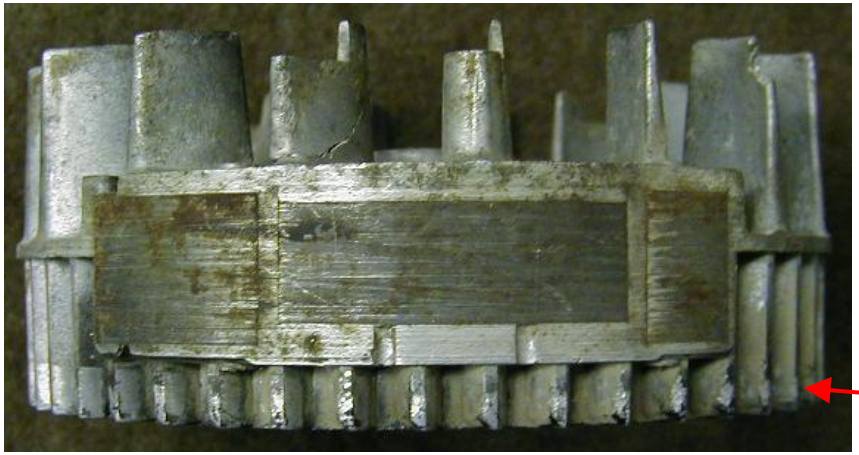
- #9 CYCLE
  - FROM BEGINNING TO END AND STARTING OVER AGAIN
- #10 FOUR STROKE ENGINE
  - TAKES 4 STROKES TO COMPLETE CYCLE
- #11 TWO STROKE ENGINE
  - TAKES 2 STROKES TO COMPLETE CYCLE

4 STROKE THEORY

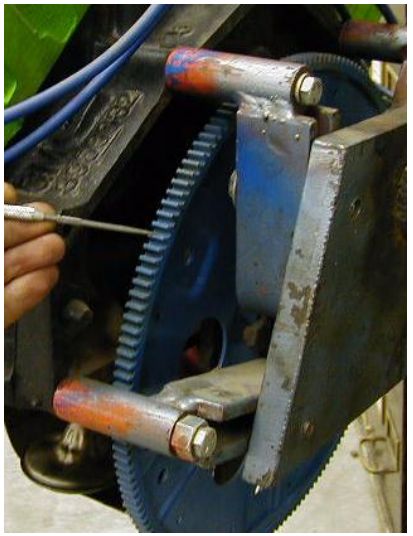
- LETS GIVE THESE NUMBERED STROKES NAMES SO WE CAN REMEMBER THEM
- BEFORE WE DO THAT, LETS ADD 3 MORE PARTS TO OUR PARTS LIST

PARTS LIST

- #5 FLYWHEEL
  - A. KEEPS ENGINE MOVING THROUGH NON-POWER STROKES
  - B. ACTS AS A FAN ON SOME AIR-COOLED ENGINES
  - C. HAS A MAGNET FOR THE MAGNETO IGNITION SYSTEM
  - D. ON SOME ENGINES, IS USED TO HELP CRANK OVER



TEETH OR GEAR



FLYWHEELS

PARTS LIST

- #6 INTAKE VALVE
  - OPENS TO LET A/F MIXTURE IN CYLINDER, CLOSES TO SEAL
- #7 EXHAUST VALVE
  - OPENS TO LET EXHAUST OUT OF CYLINDER, CLOSES TO SEAL
- INTAKE IS BIGGER THAN EXHAUST WHEN THERE IS A DIFFERENCE IN SIZE.

ENGINE NOTES

- BACK AT OUR NOTES PAGE
- #12 FIVE MAIN ENGINE PARTS
  - PISTON
  - CYLINDER
  - CRANKSHAFT
  - CONNECTING ROD
  - FLYWHEEL

ALL PISTON ENGINES HAVE THESE 5 MAIN PARTS

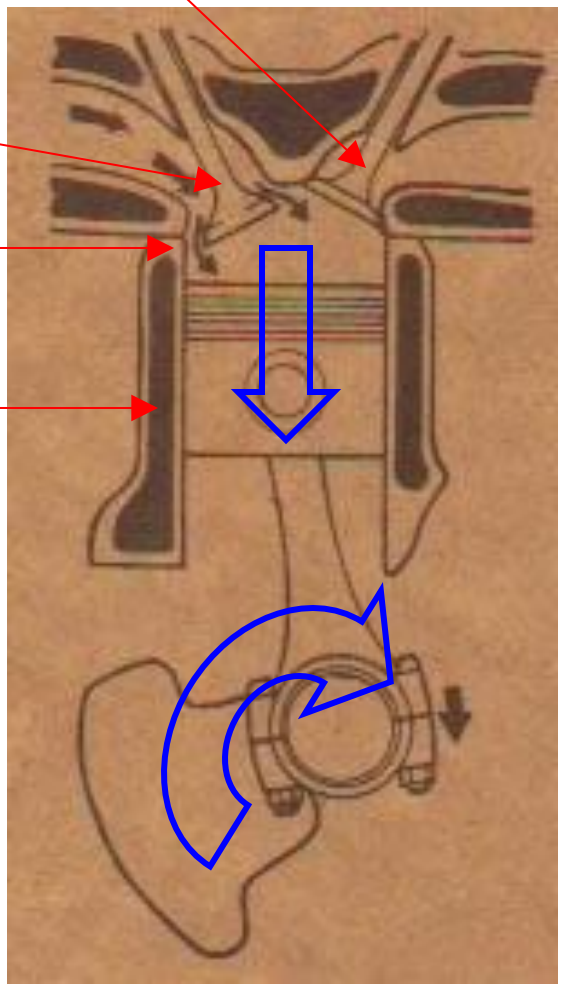
4 STROKE THEORY

EXHAUST VALVE CLOSED

INTAKE VALVE OPEN

LETS START WITH THE PISTON AT TDC

THE STROKE IS FINISHED WHEN THE PISTON REACHES BDC



THIS IS CALLED THE

INTAKE STROKE

THIS STROKE CREATES A VACUUM IN THE CYLINDER AND SUCKS THE A/F MIXTURE INTO THE CYLINDER

4 STROKE THEORY

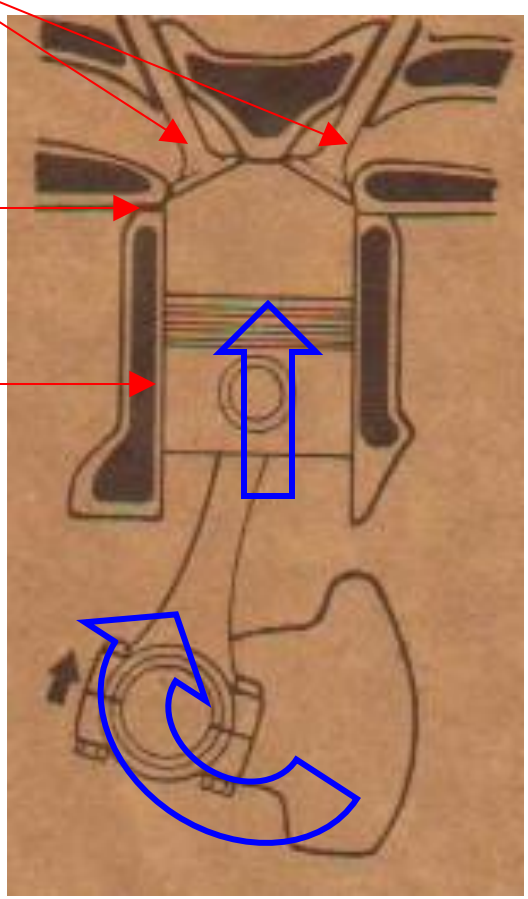
INTAKE AND EXHAUST VALVES BOTH CLOSED

PISTON MOVES TO TDC

PISTON STARTS AT BDC

THIS IS CALLED THE COMPRESSION STROKE

THE A/F MIXTURE THAT WAS SUCKED INTO THE CYLINDER NOW IS TRAPPED AND SQUEEZED DOWN TO A SMALL SPACE CREATING PRESSURE AND HEAT



4 STROKE THEORY

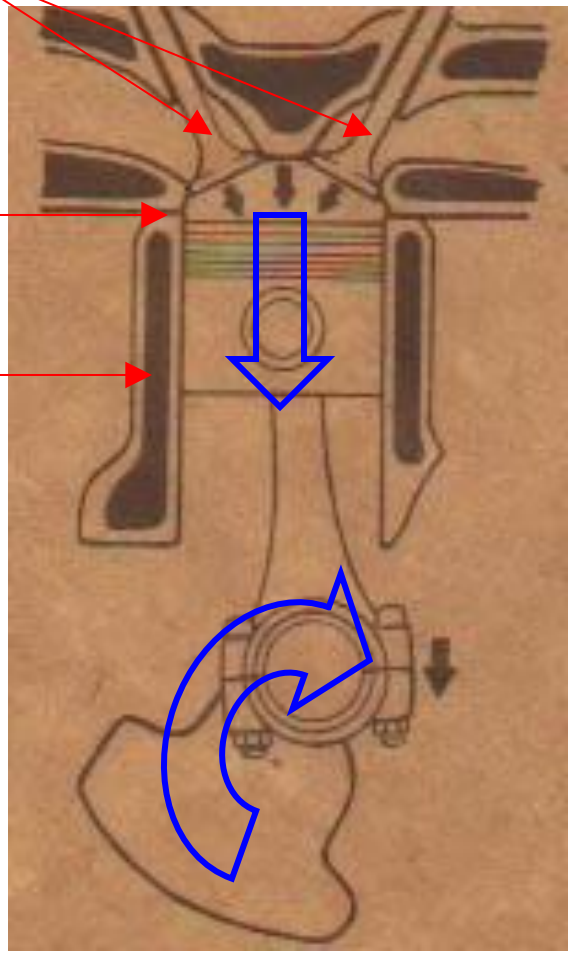
INTAKE AND EXHAUST VALVES BOTH STAY CLOSED

THE PISTON STARTS AT TDC

THE STROKE IS FINISHED WHEN THE PISTON REACHES BDC

THIS IS CALLED THE POWER STROKE

A/F MIXTURE EXPLODES AND BURNS RAPIDLY CAUSING THE PISTON TO BE BLOWN DOWN IN THE CYLINDER. THIS IS WHAT MAKES THE ENGINE RUN.



4 STROKE THEORY

EXHAUST VALVE OPENS

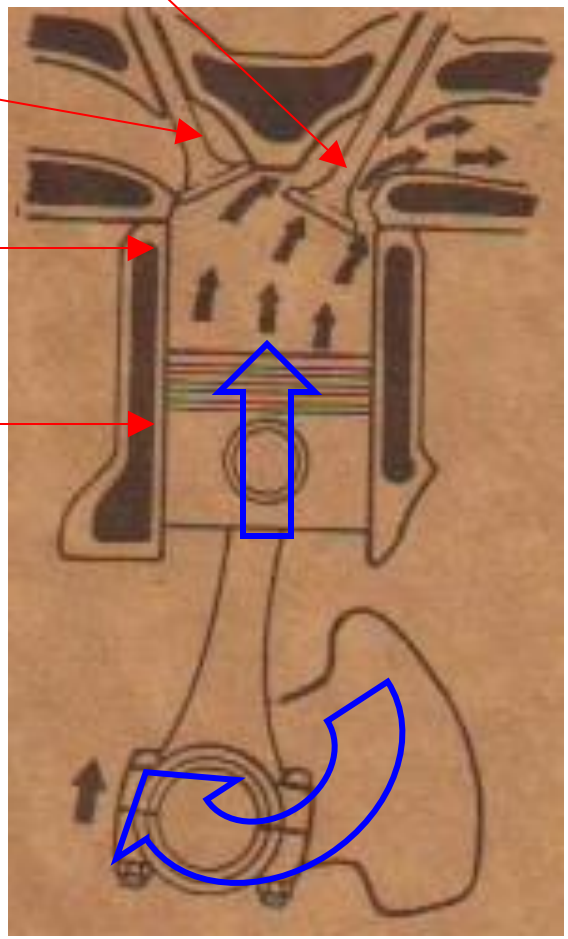
INTAKE VALVE STAYS CLOSED

PISTON MOVES TO TDC

PISTON STARTS AT BDC

THIS IS CALLED THE EXHAUST STROKE

BURNT A/F MIXTURE IS PUSHED OUT OPEN EXHAUST VALVE AS PISTON MOVES UP.



ENGINE NOTES

- LETS ADD TO OUR CHART.

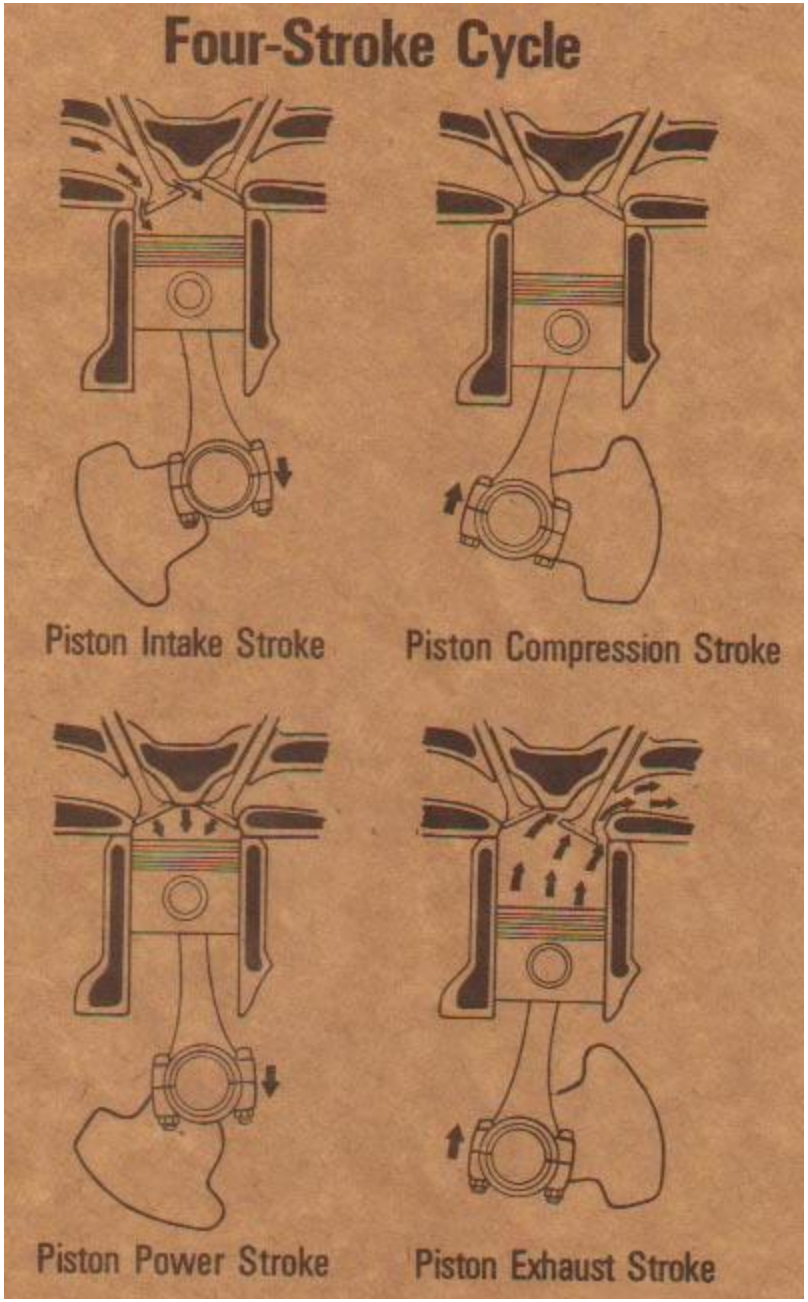
STROKE NAME	PISTON MOVEMENT	INTAKE VALVE	EXHAUST VALVE	A/F MIXTURE
INTAKE	TDC TO BDC	OPEN	CLOSED	SUCKED INTO CYLINDER
COMPRESSION	BDC TO TDC	CLOSED	CLOSED	SQUEEZED DOWN
POWER	TDC TO BDC	CLOSED	CLOSED	EXPLODING, BURNING
EXHAUST	BDC TO TDC	CLOSED	OPEN	PUSHED OUT OF CYLINDER

REVIEW 4 STROKE CYCLE

INTAKE
COMPRESSION
POWER
EXHAUST
CYCLE

INTAKE
COMPRESSION
POWER
EXHAUST
CYCLE

INTAKE
COMPRESSION
POWER
EXHAUST
CYCLE



4 STROKE THEORY

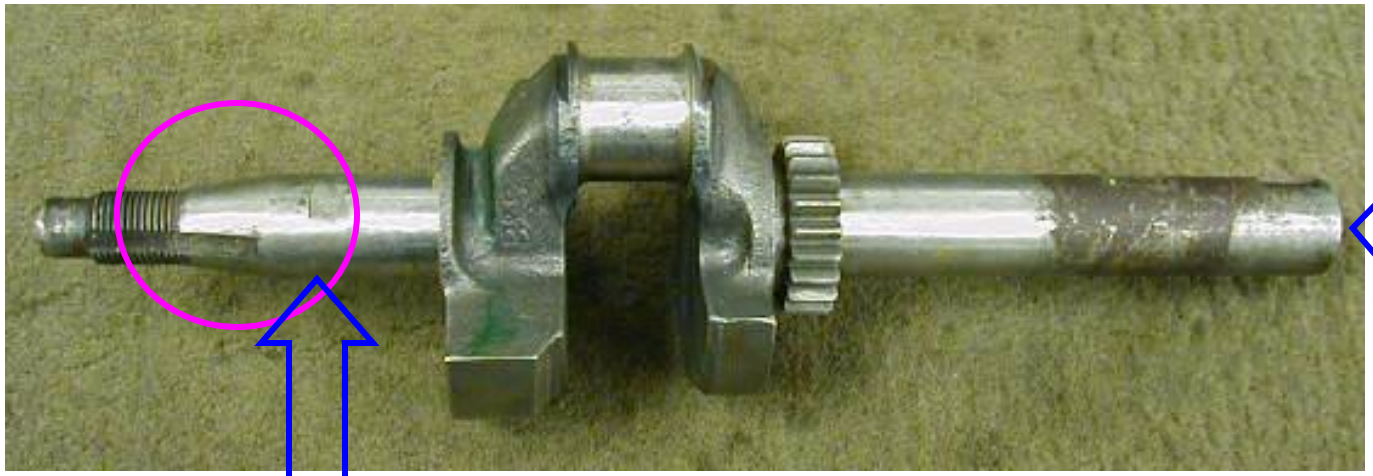
- HOW FAR DOES THE CRANKSHAFT TURN DURING ONE STROKE?
- HOW FAR DOES THE CRANKSHAFT TURN DURING ONE CYCLE?

ENERGY CONVERSION

- CAN'T CREATE OR DESTROY ENERGY.
- CAN ONLY CHANGE ENERGY'S FORM
- ON THE POWER STROKE THE *CHEMICAL* ENERGY IN THE FUEL IS CHANGED TO *HEAT* ENERGY BY BURNING
- THE *HEAT* ENERGY CREATES PRESSURE CAUSING THE PISTON TO BE BLOWN DOWN IN THE CYLINDER WHICH IS *MECHANICAL* ENERGY
- THIS *MECHANICAL* ENERGY STORES *KINETIC* ENERGY IN THE FLYWHEEL
- THE *KINETIC* ENERGY IN THE FLYWHEEL KEEPS THE CRANK MOVING THROUGH THE EXHAUST, INTAKE, AND BACK TO TDC ON COMPRESSION STROKES READY TO DO IT AGAIN
- INERTIA? *(FOOTBALL PASS PLAY)*

ENGINE NOTES

- #14 PTO
  - POWER TAKE OFF (WHERE WE GET POWER OUT OF THE ENGINE)

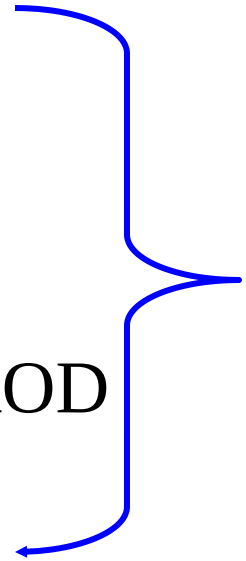


PTO END OF CRANK

FLYWHEEL END
OR MAGNETO END

PARTS LIST REVIEW

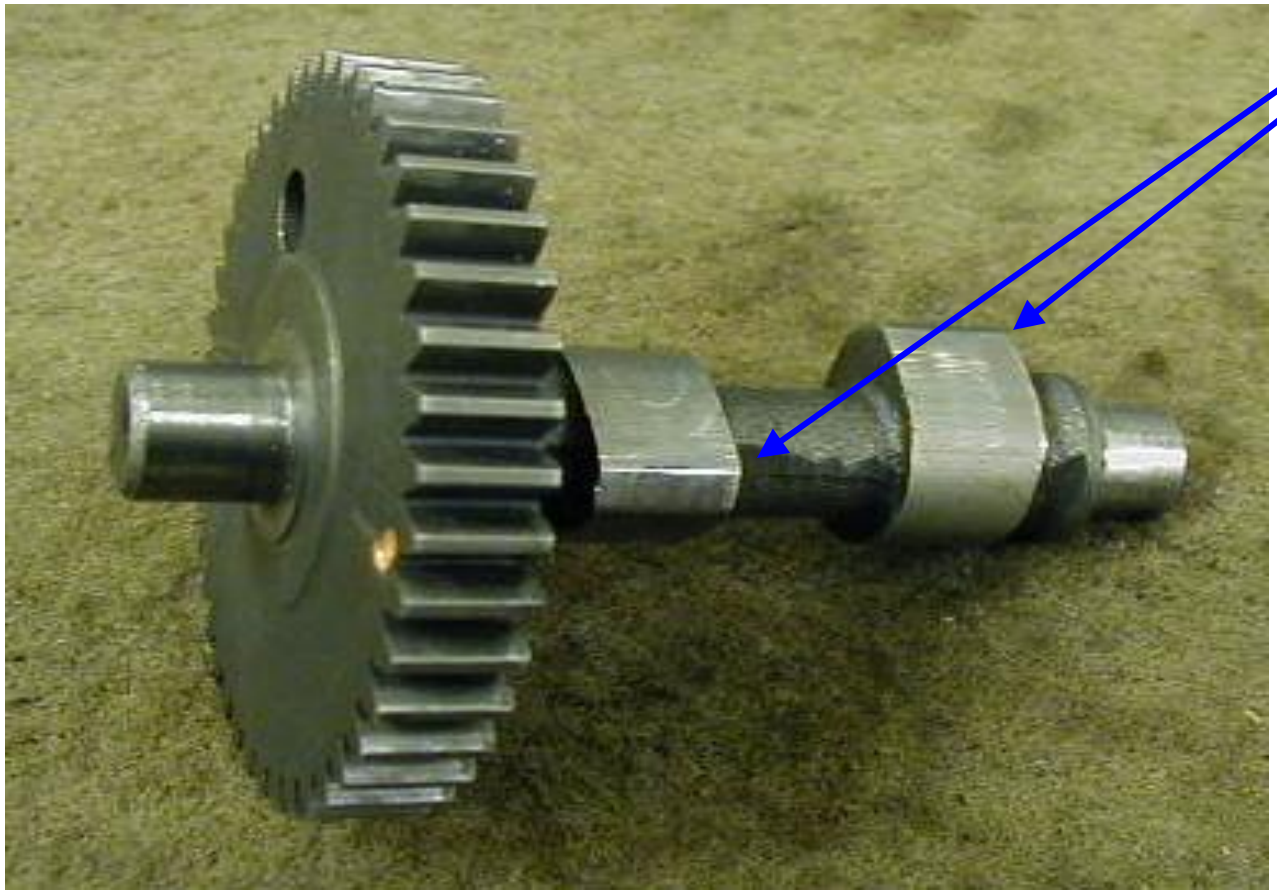
- #1 PISTON
- #2 CYLINDER
- #3 CRANKSHAFT
- #4 CONNECTING ROD
- #5 FLYWHEEL
- #6 INTAKE VALVE
- #7 EXHAUST VALVE



5 MAIN ENGINE PARTS THAT ***ALL*** PISTON ENGINES HAVE

PARTS LIST

- #8 CAMSHAFT
  - A. OPENS VALVES AT THE PROPER TIME
  - B. *(LEAVE SPACE FOR LATER)*

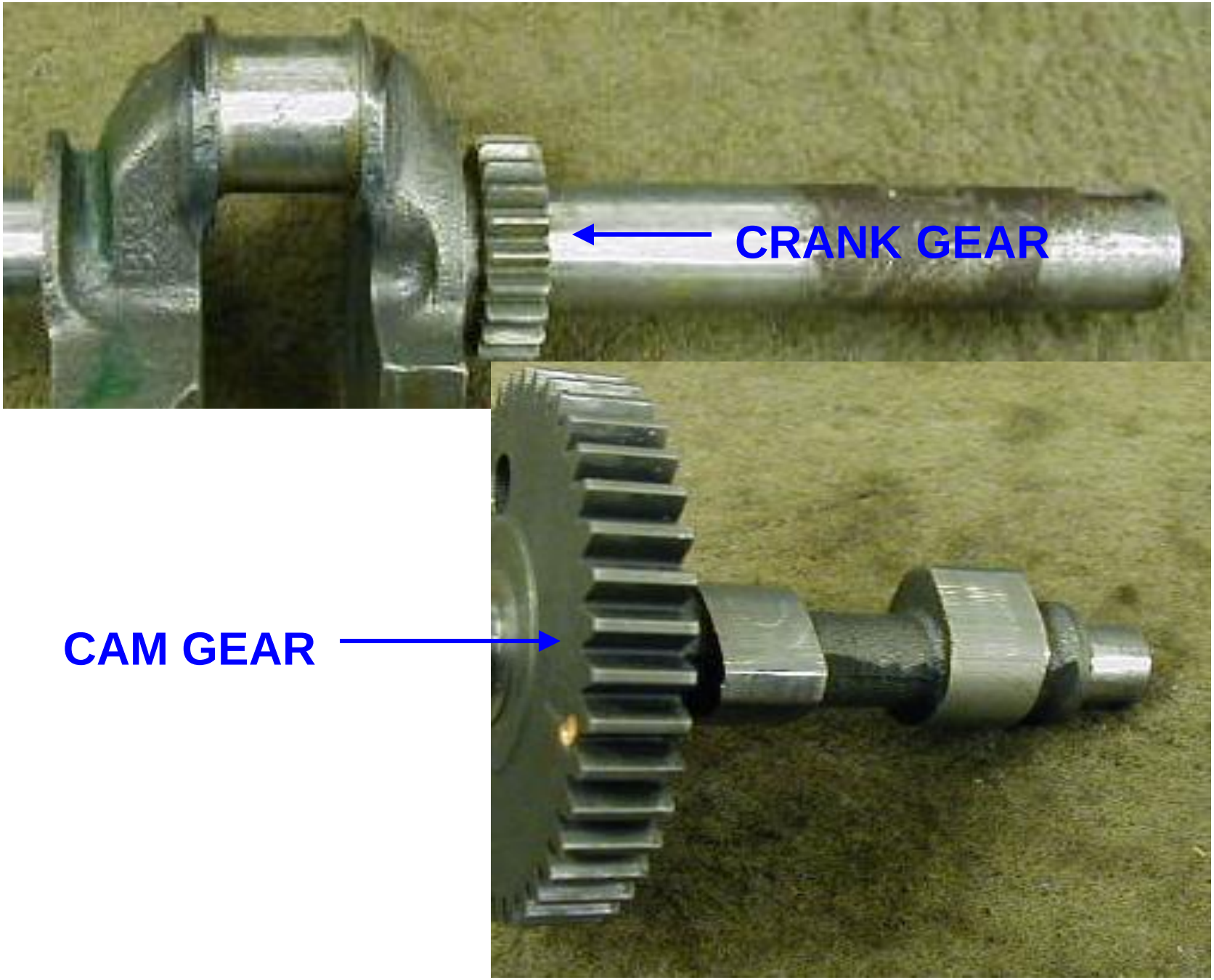


NOTICE LOBES

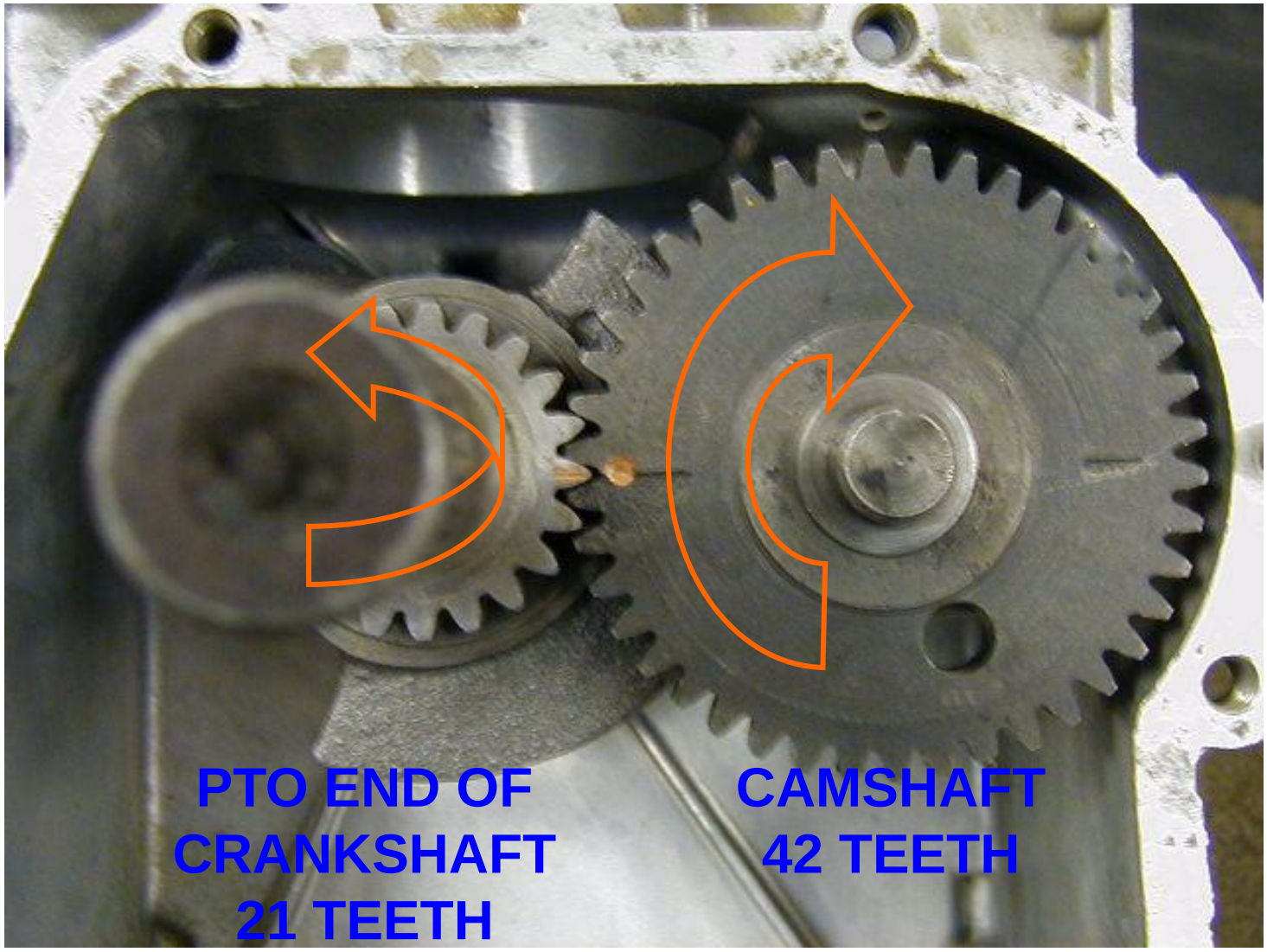
ONE FOR THE INTAKE VALVE

ONE FOR THE EXHAUST

RAMPS TO PUSH OPEN THE VALVES

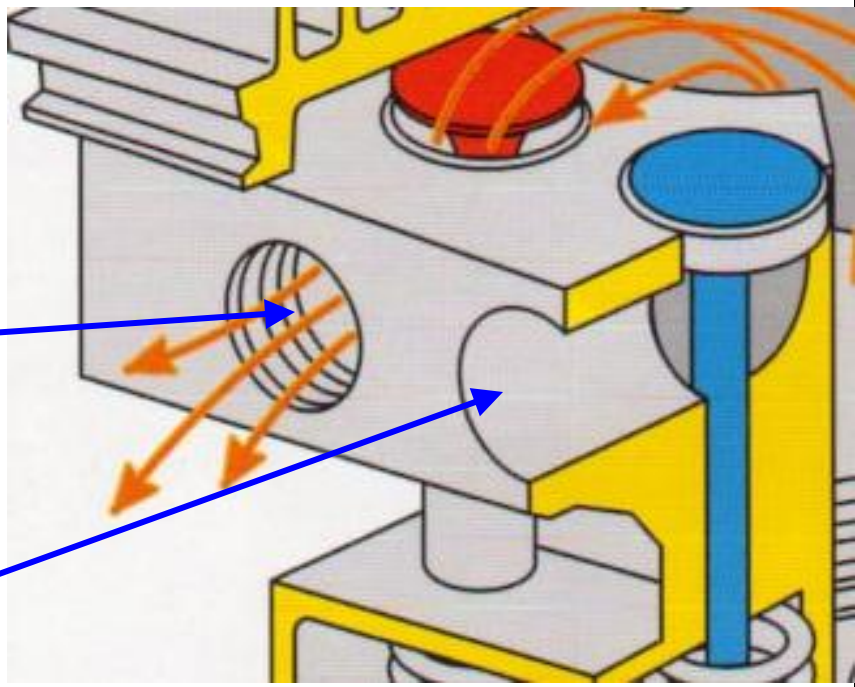

CRANK GEAR
CAM GEAR

CRANKSHAFT DRIVING THE CAMSHAFT



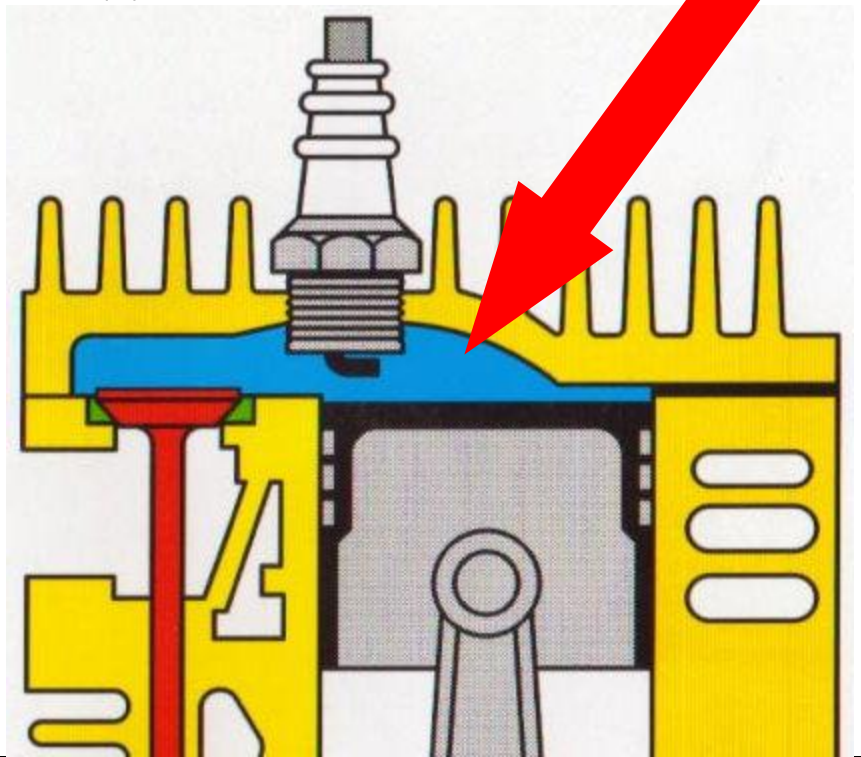
PARTS LIST

- #9 INTAKE PORT
  - PASSAGE FOR A/F MIXTURE TO ENTER CYLINDER (WHEN VALVE IS OPEN)
- #10 EXHAUST PORT
  - PASSAGE FOR EXHAUST TO LEAVE CYLINDER (WHEN THE VALVE IS OPEN)

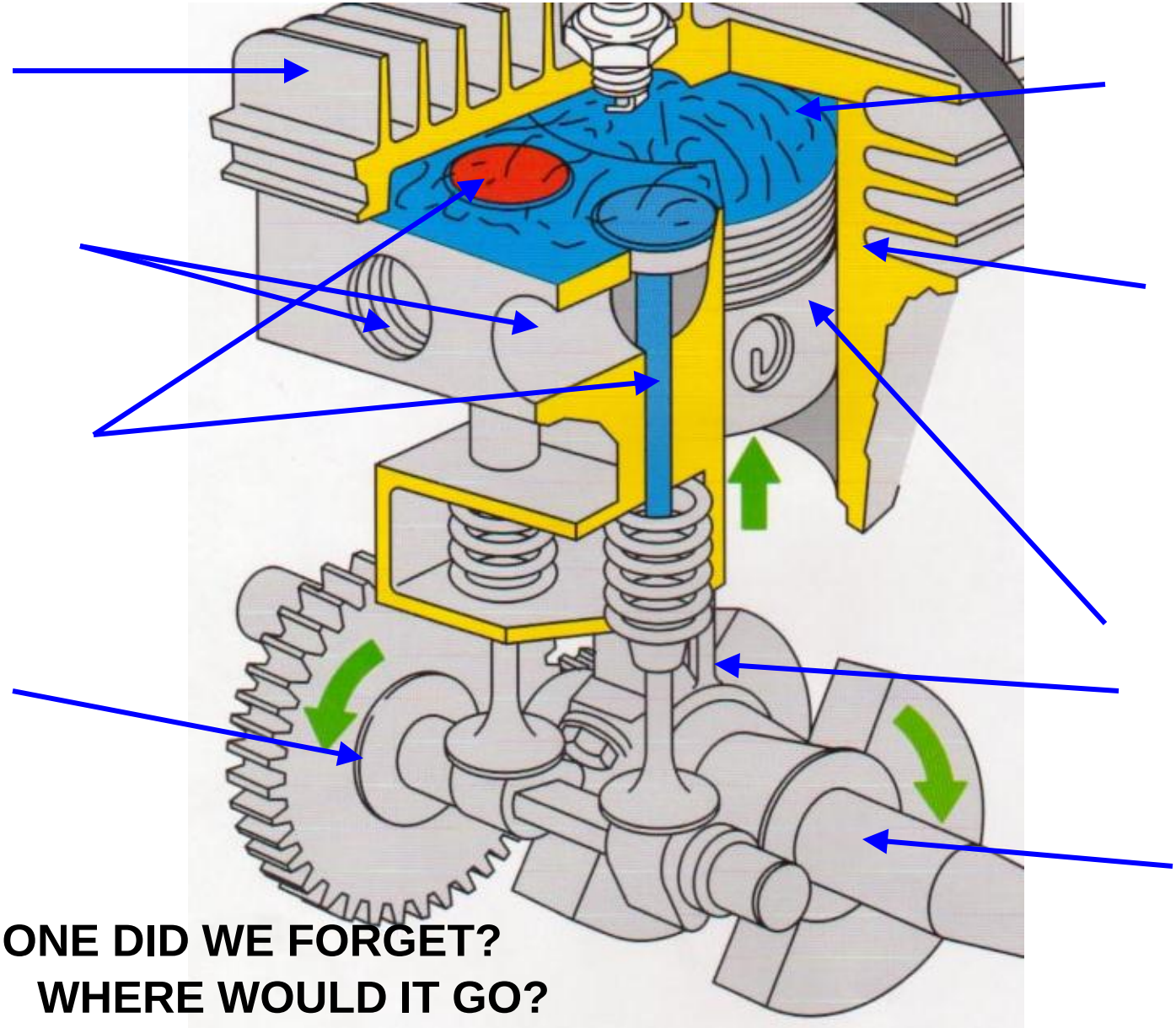


PARTS LIST

- #11 CYLINDER HEAD (HEAD)
  - SEAL FOR TOP OF CYLINDER
- #12 COMBUSTION CHAMBER
  - AREA ABOVE PISTON, UNDER CYLINDER HEAD WHERE COMBUSTION TAKES PLACE



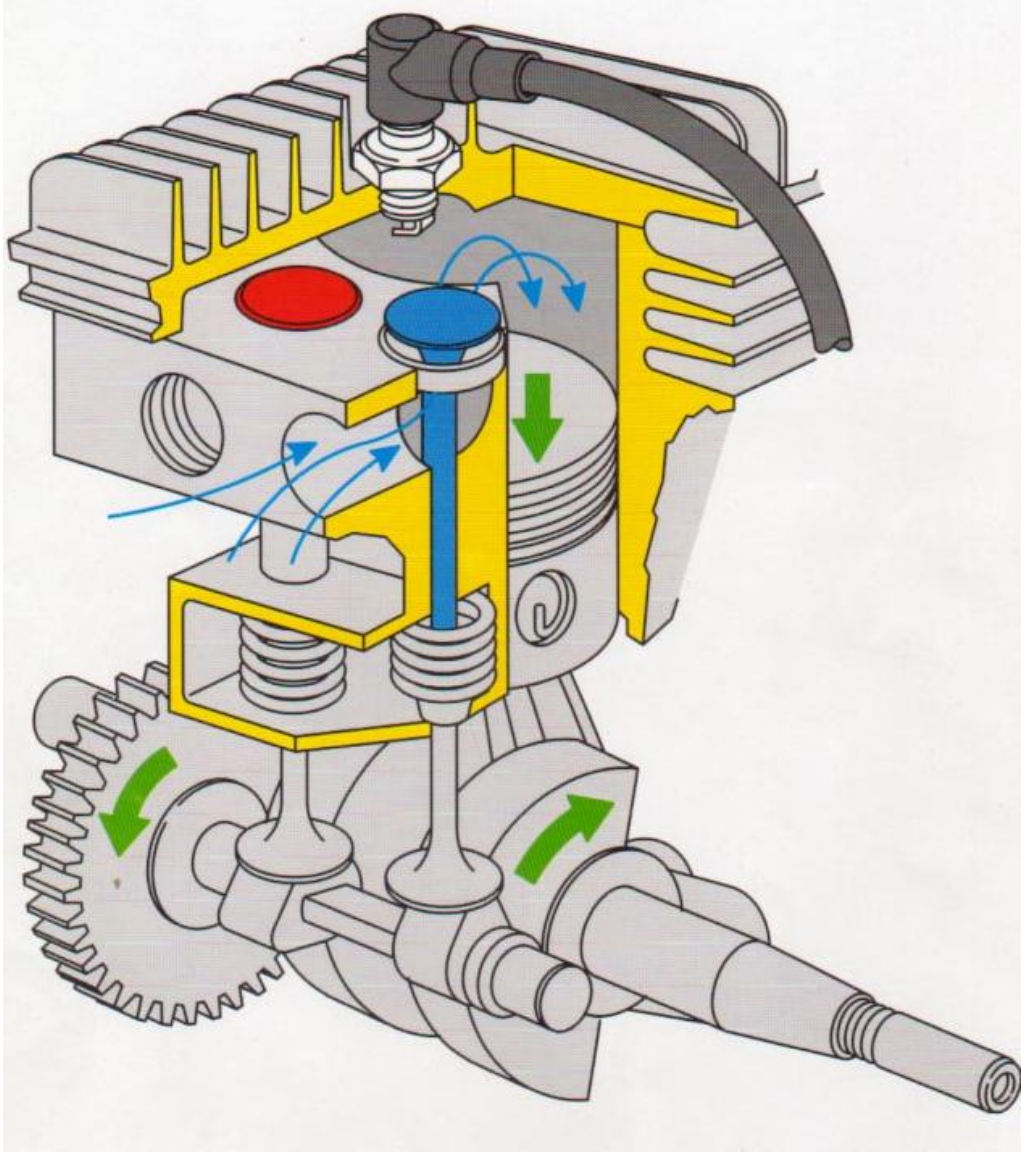
PICK OUT THE PARTS



WHICH ONE DID WE FORGET?

WHERE WOULD IT GO?

4 STROKE THEORY
PARTS PUT TOGETHER



THREE QUESTIONS

WHICH STROKE?

HOW CAN YOU TELL?

HOW FAR DID THE CRANK TURN DURING THIS STROKE?

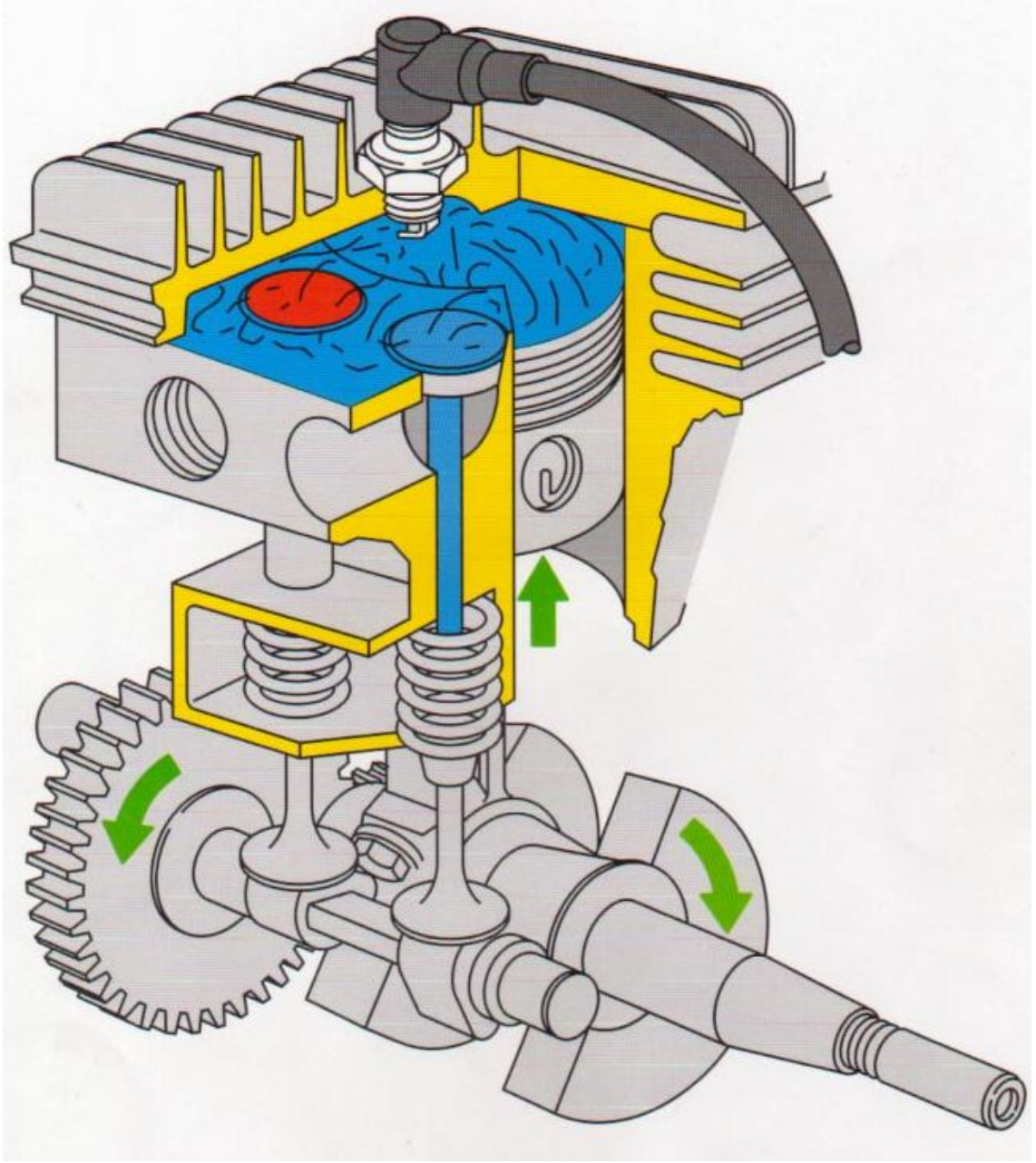
4 STROKE THEORY

THREE QUESTIONS

WHICH STROKE?

HOW CAN YOU TELL?

HOW FAR DID THE CRANKSHAFT TURN DURING THIS STROKE?



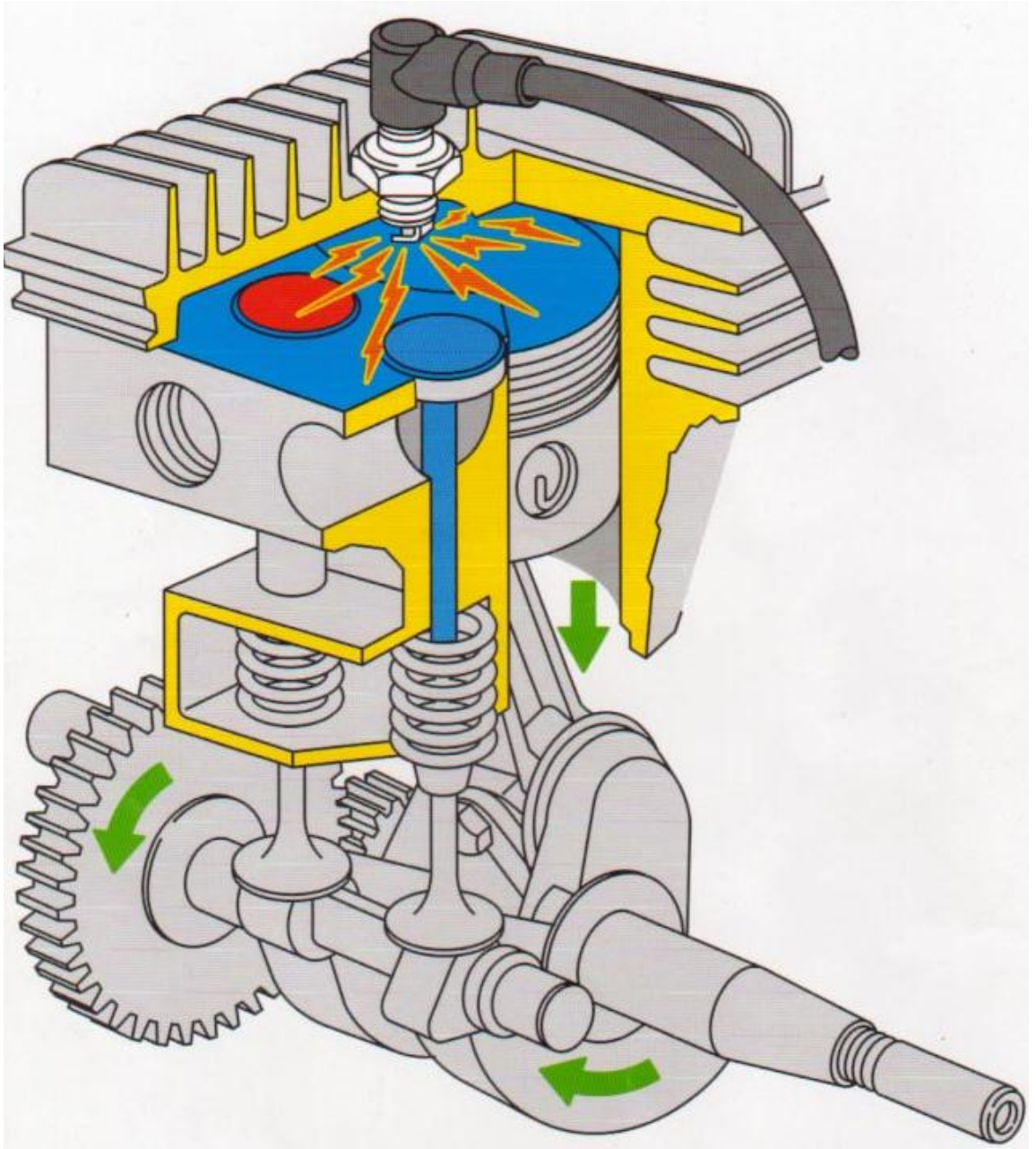
4 STROKE THEORY

THREE QUESTIONS

WHICH STROKE?

HOW CAN YOU TELL?

HOW FAR DID THE CRANKSHAFT TURN DURING THIS STROKE?



4 STROKE THEORY

QUESTIONS

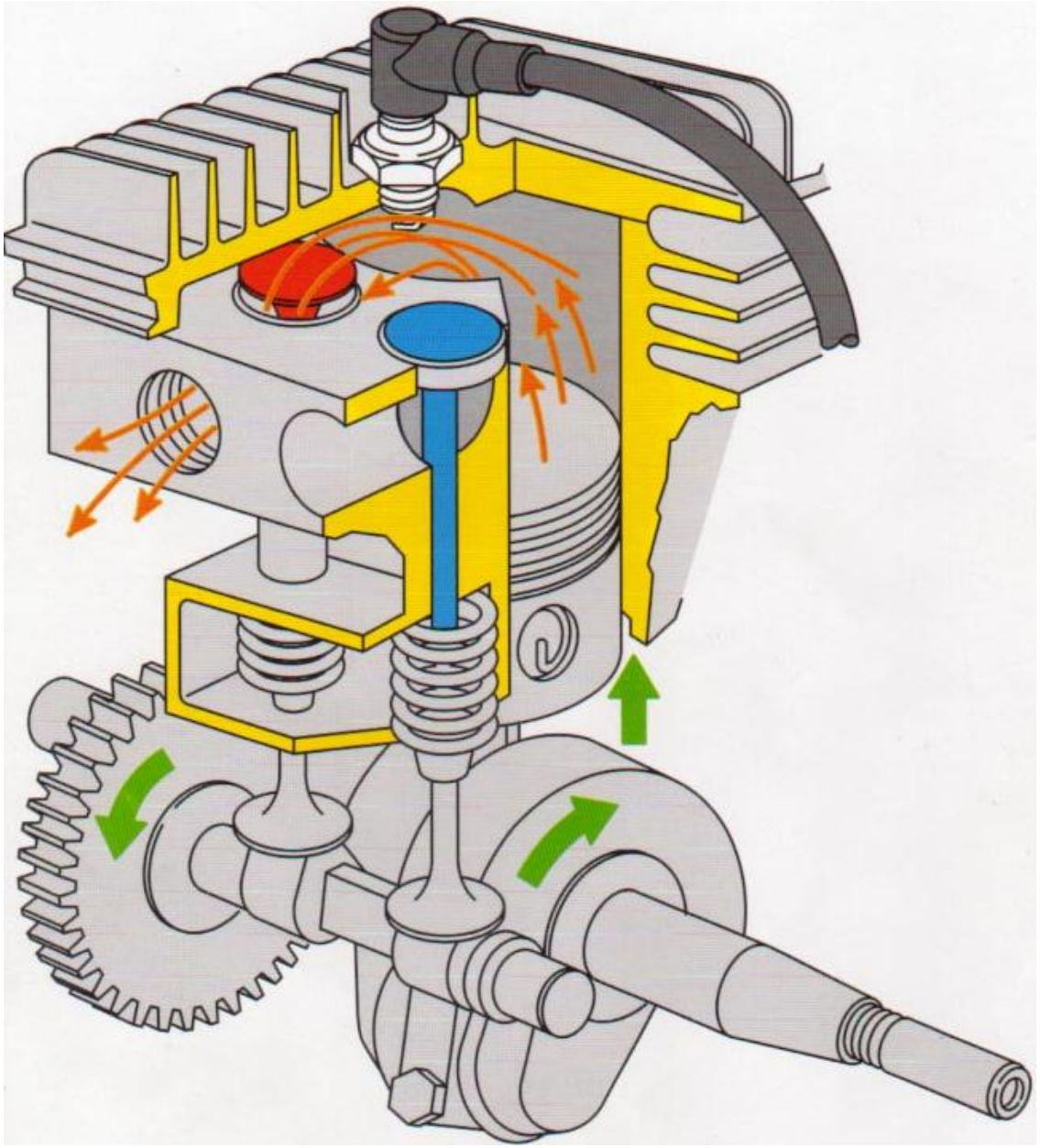
WHICH STROKE?

HOW CAN YOU TELL?

HOW FAR DID THE CRANKSHAFT TURN DURING THIS STROKE?

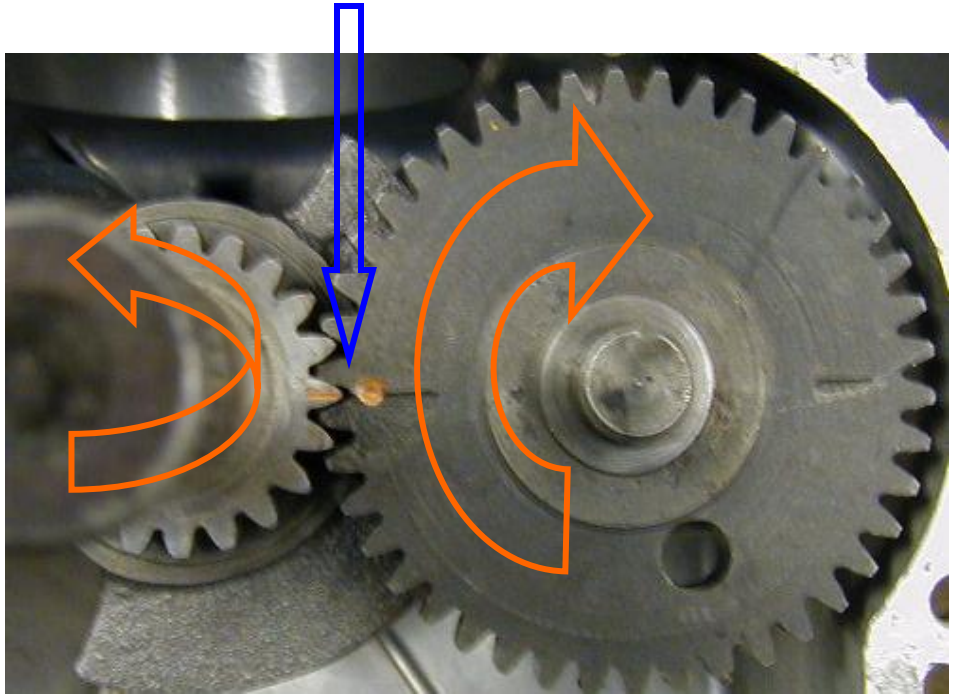
WHAT ARE THE STROKES THAT THE PISTON MOVES FROM TDC TO BDC?

HOW DO YOU TELL THE DIFFERENCE?



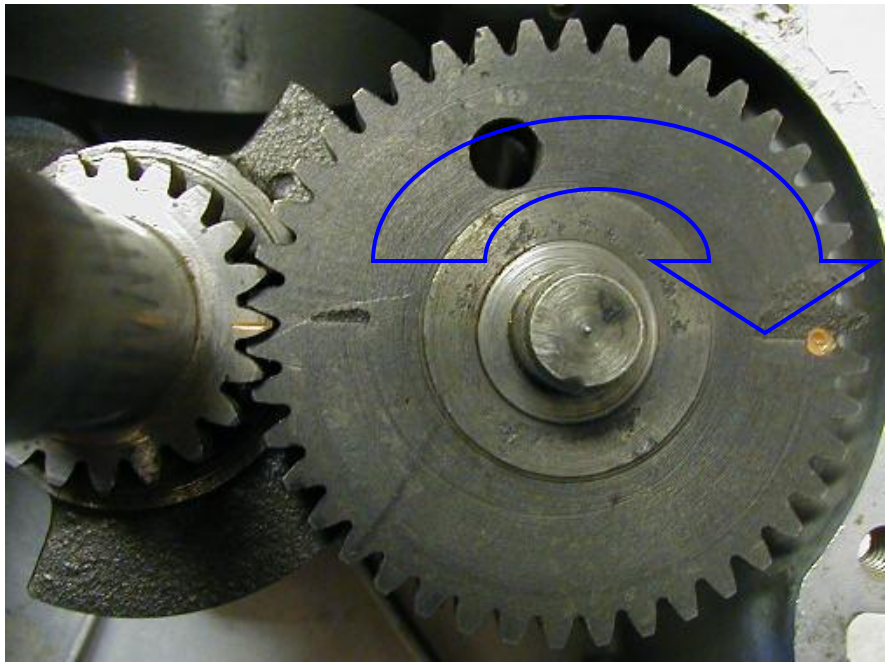
HOW FAST DOES THE CAMSHAFT ROTATE COMPARED TO THE CRANKSHAFT?

TIMING MARKS

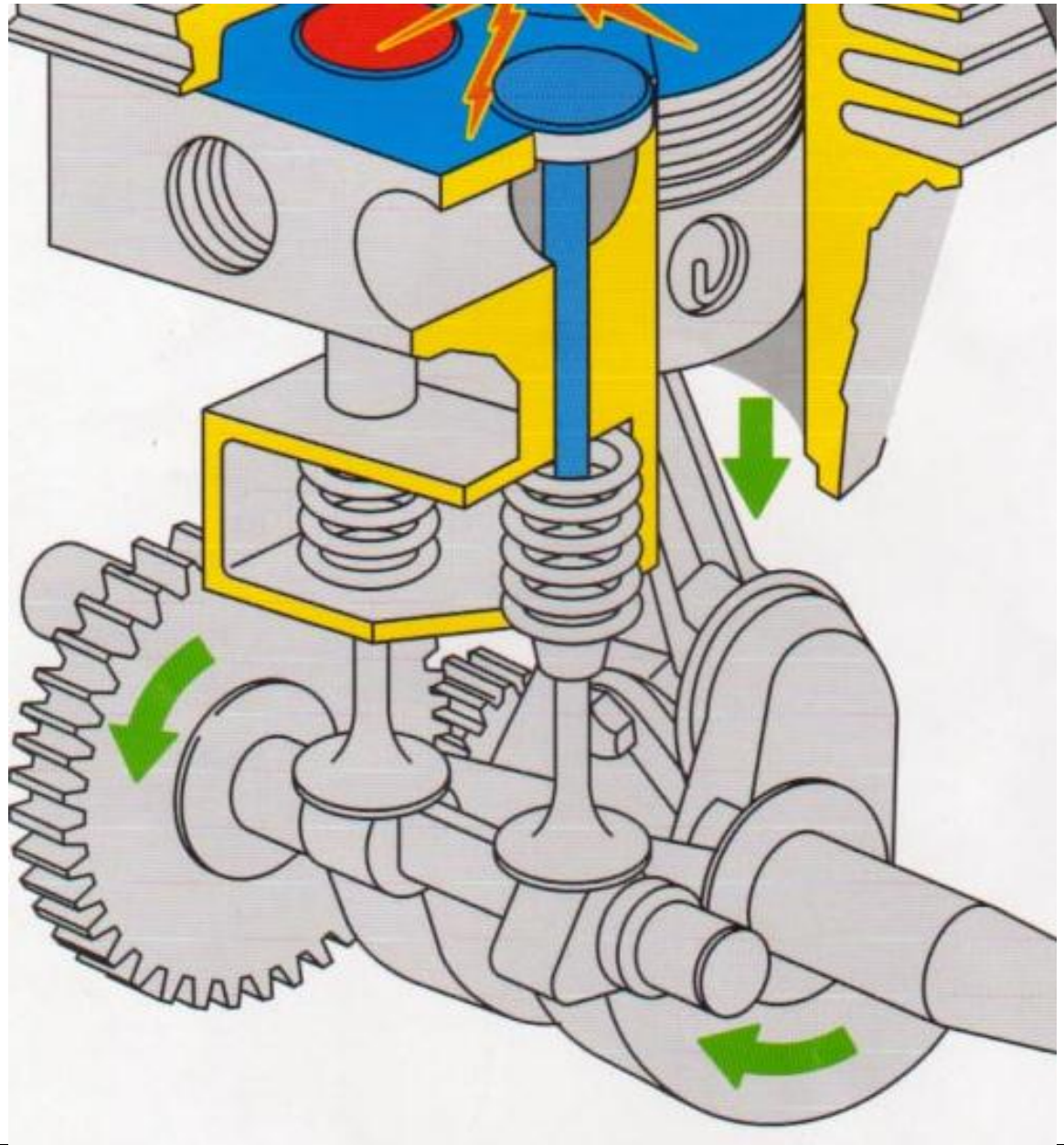


1 TURN

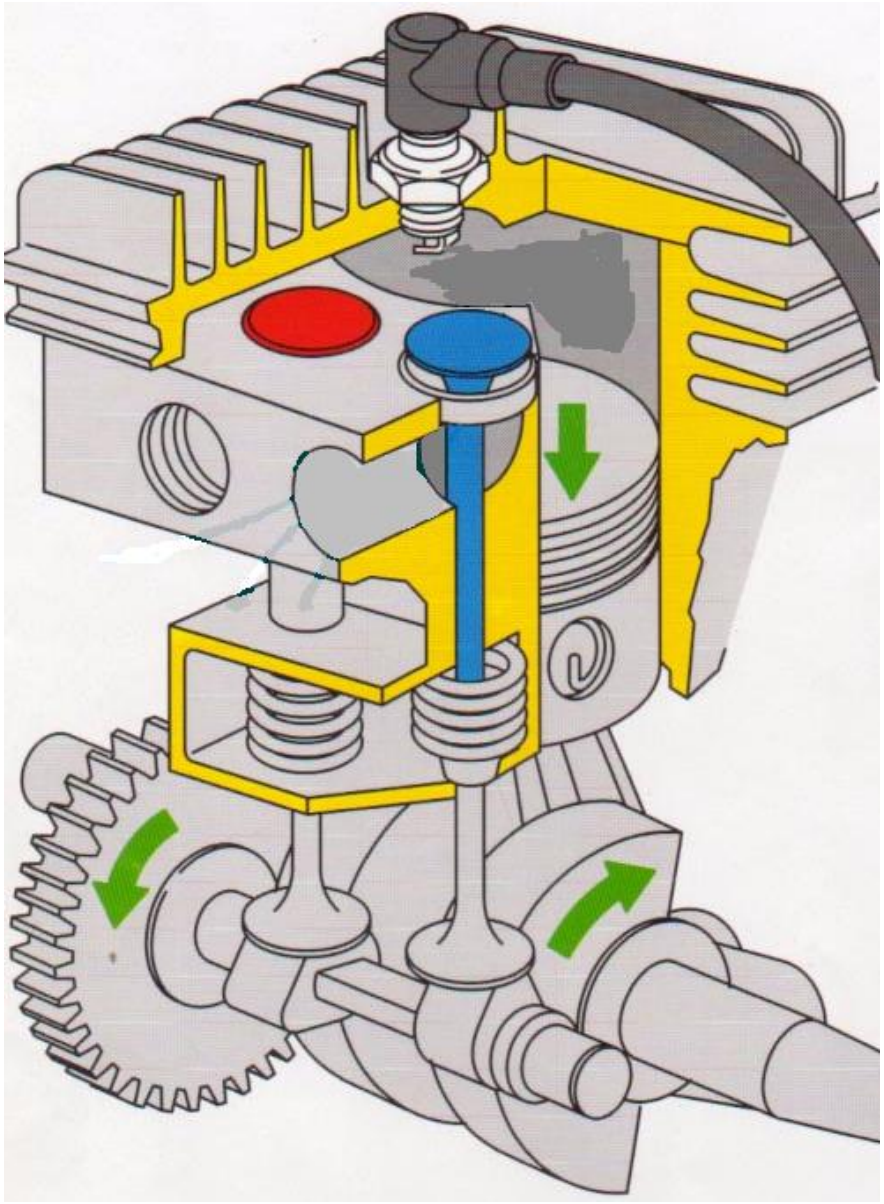
1/2 TURN



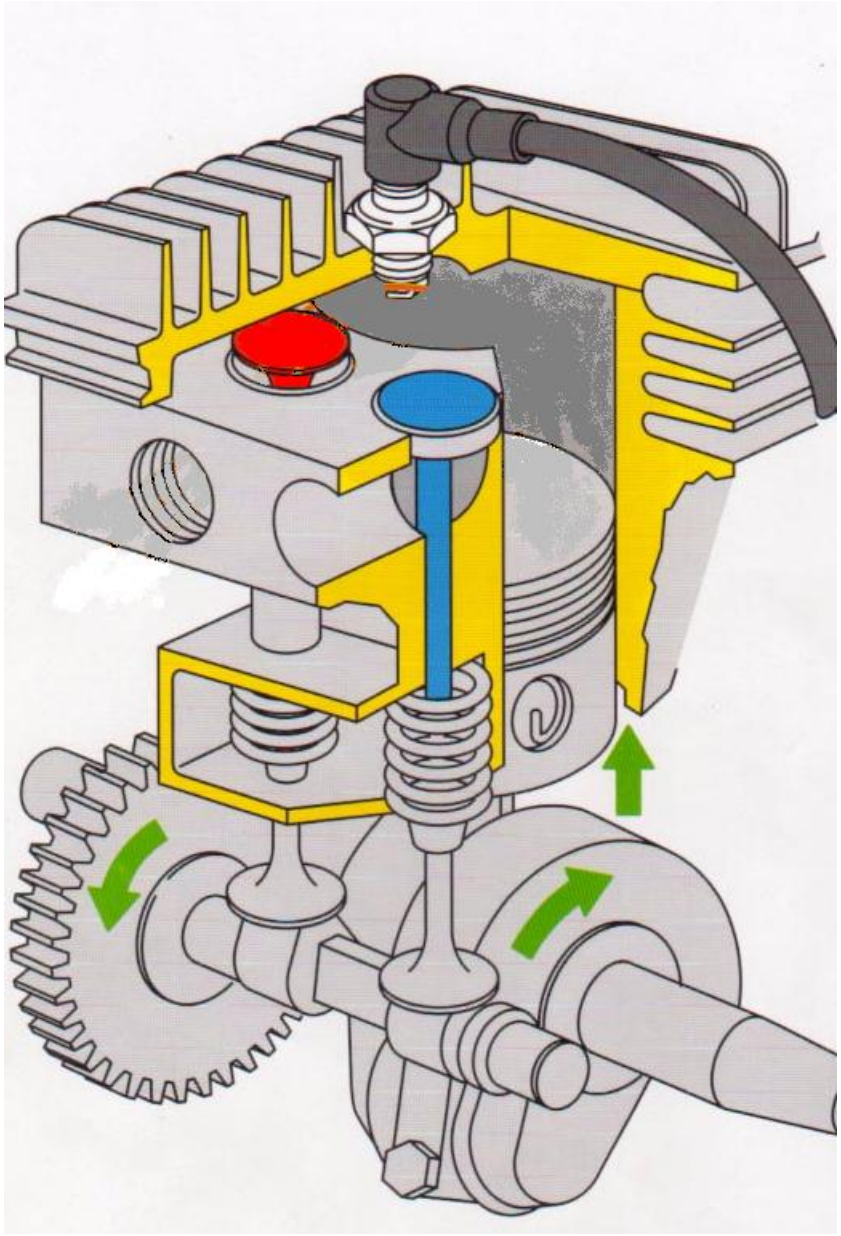
WHICH STROKE?



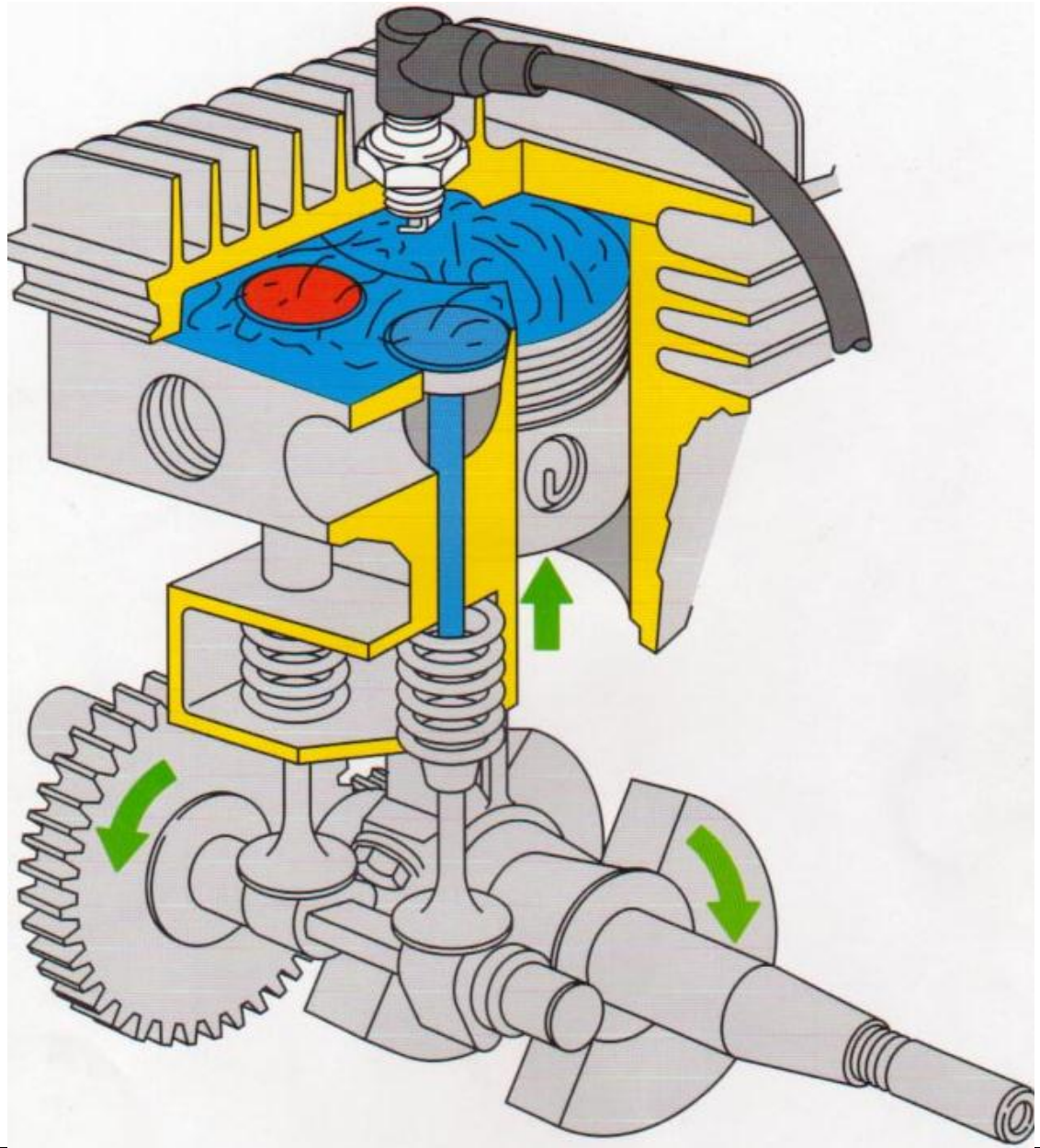
WHICH STROKE?



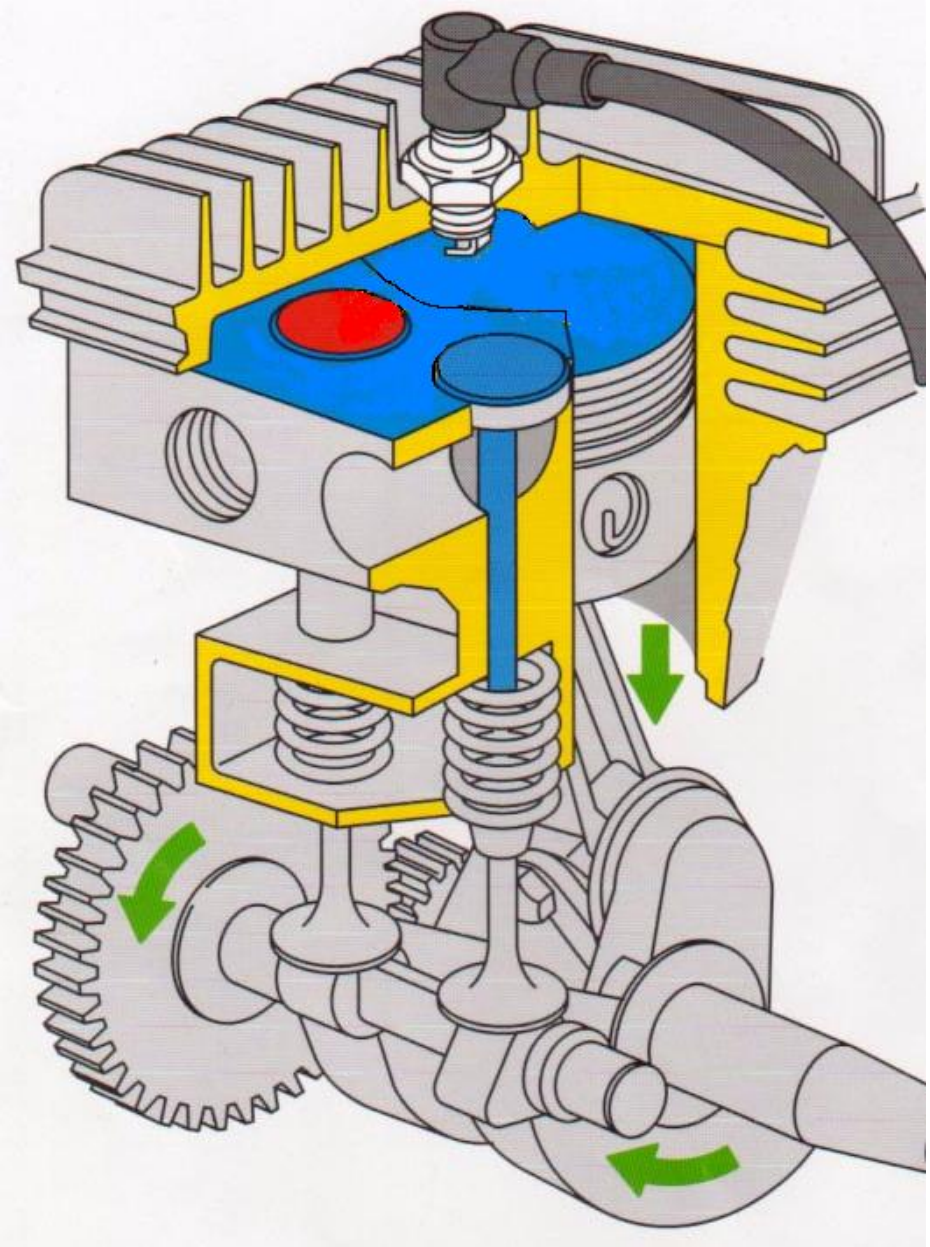
WHICH STROKE?

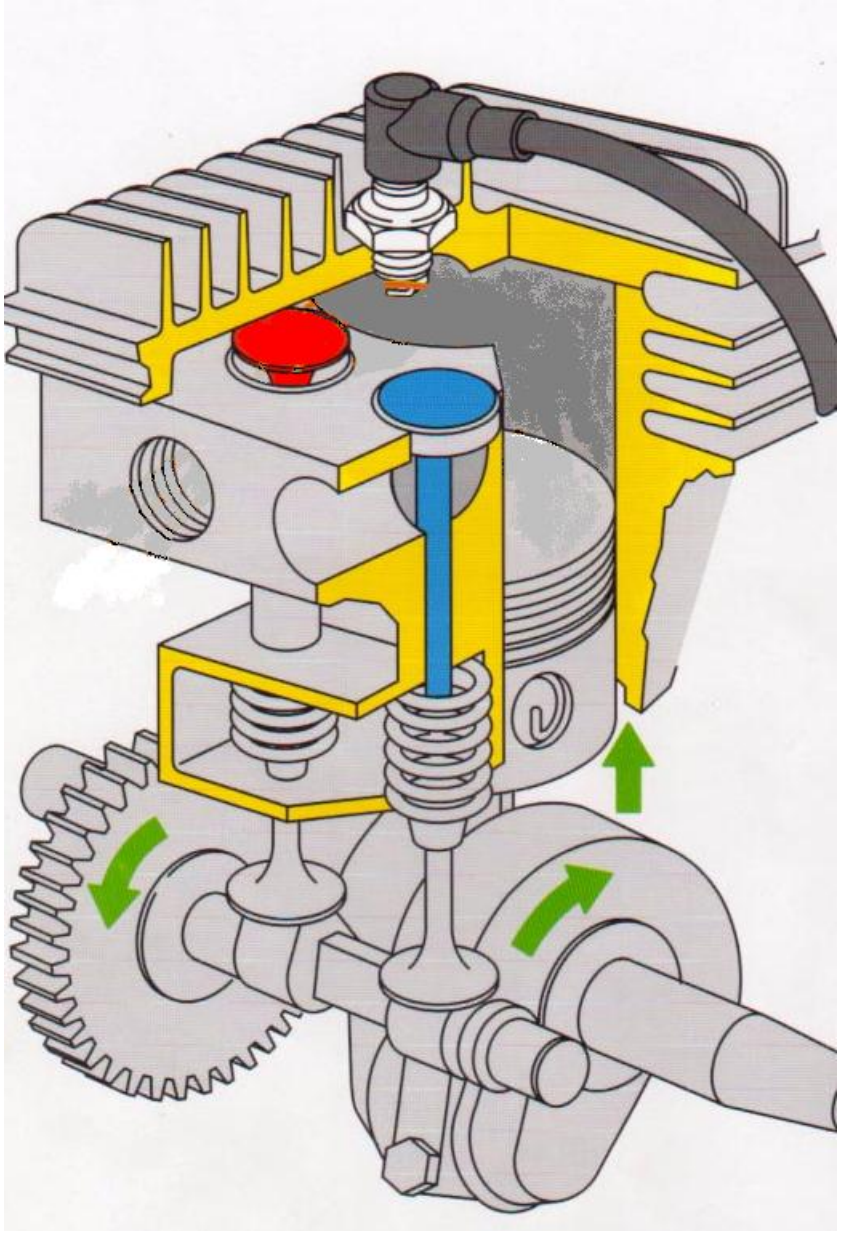


WHICH STROKE?

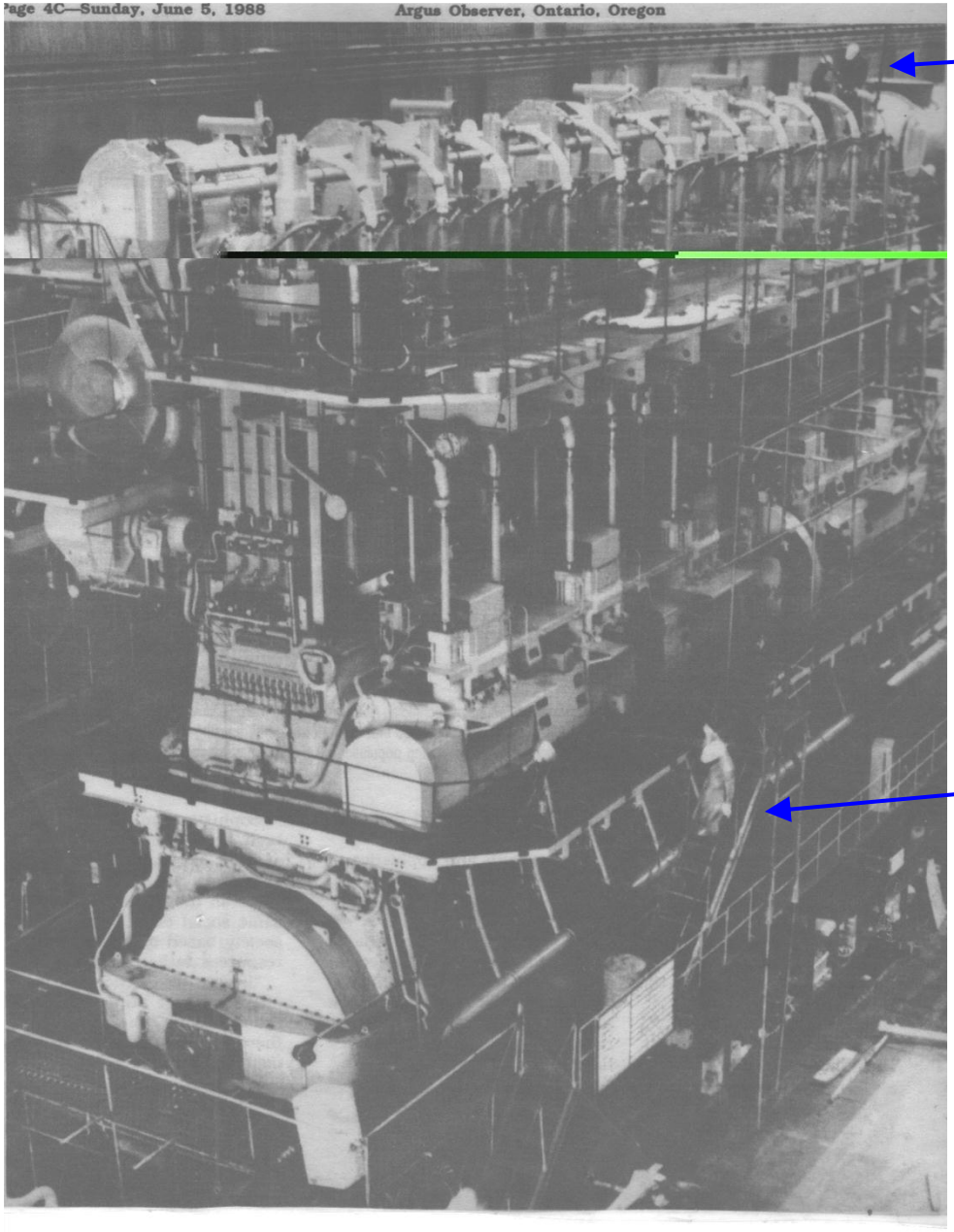


WHICH STROKE?





12 CYLINDER ENGINE OUT OF CRUISE LINER



PERSON

WEIGHS
3,400,000 LBS.

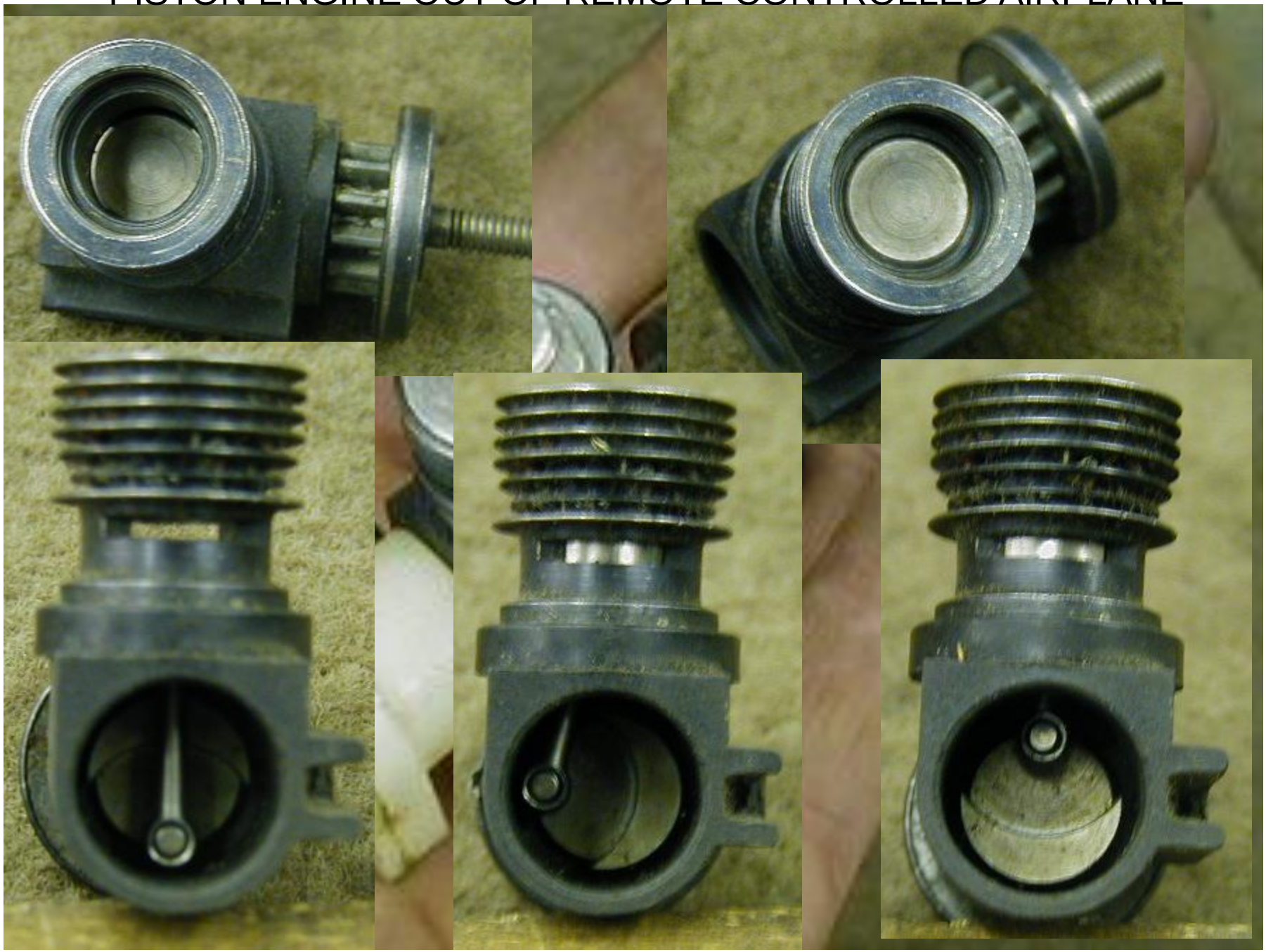
71 FEET

PERSON GOING DOWN A LADDER

57,000 HORSE-POWER

41 FEET

PISTON ENGINE OUT OF REMOTE CONTROLLED AIRPLANE



ENGINE NOTES

- #16 R.P.M.
  - REVOLUTIONS PER MINUTE
    - WE MEASURE ENGINE SPEED BY RPM OF CRANKSHAFT
- #17 R.P.S.
  - REVOLUTIONS PER SECOND

INDY CAR ENGINE SPEED

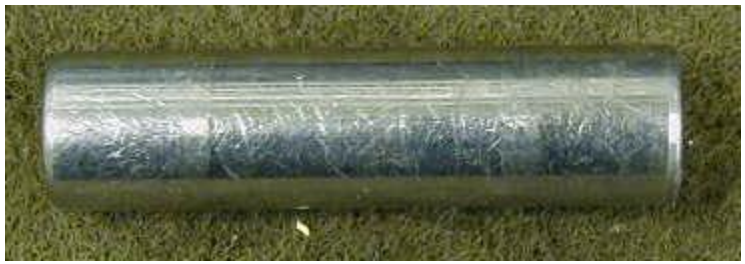
SOMETIMES AS HIGH AS 15,000 RPM

THAT'S SPINNING THE CRANKSHAFT AROUND ***250*** TIMES PER

SECOND OR ***500*** STROKES PER SECOND

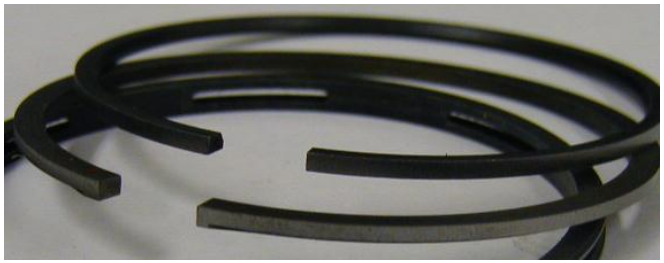
PARTS LIST

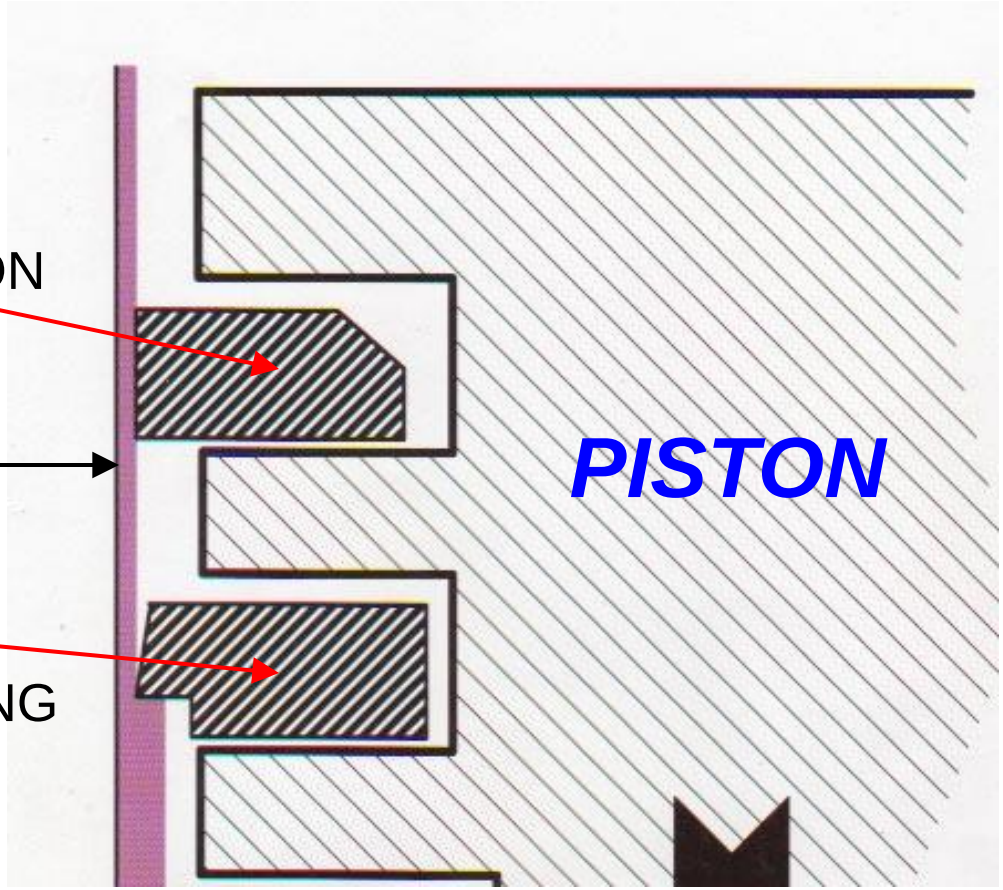
- #13 PISTON PIN (WRIST PIN)
  - CONNECTS CONNECTING ROD TO PISTON



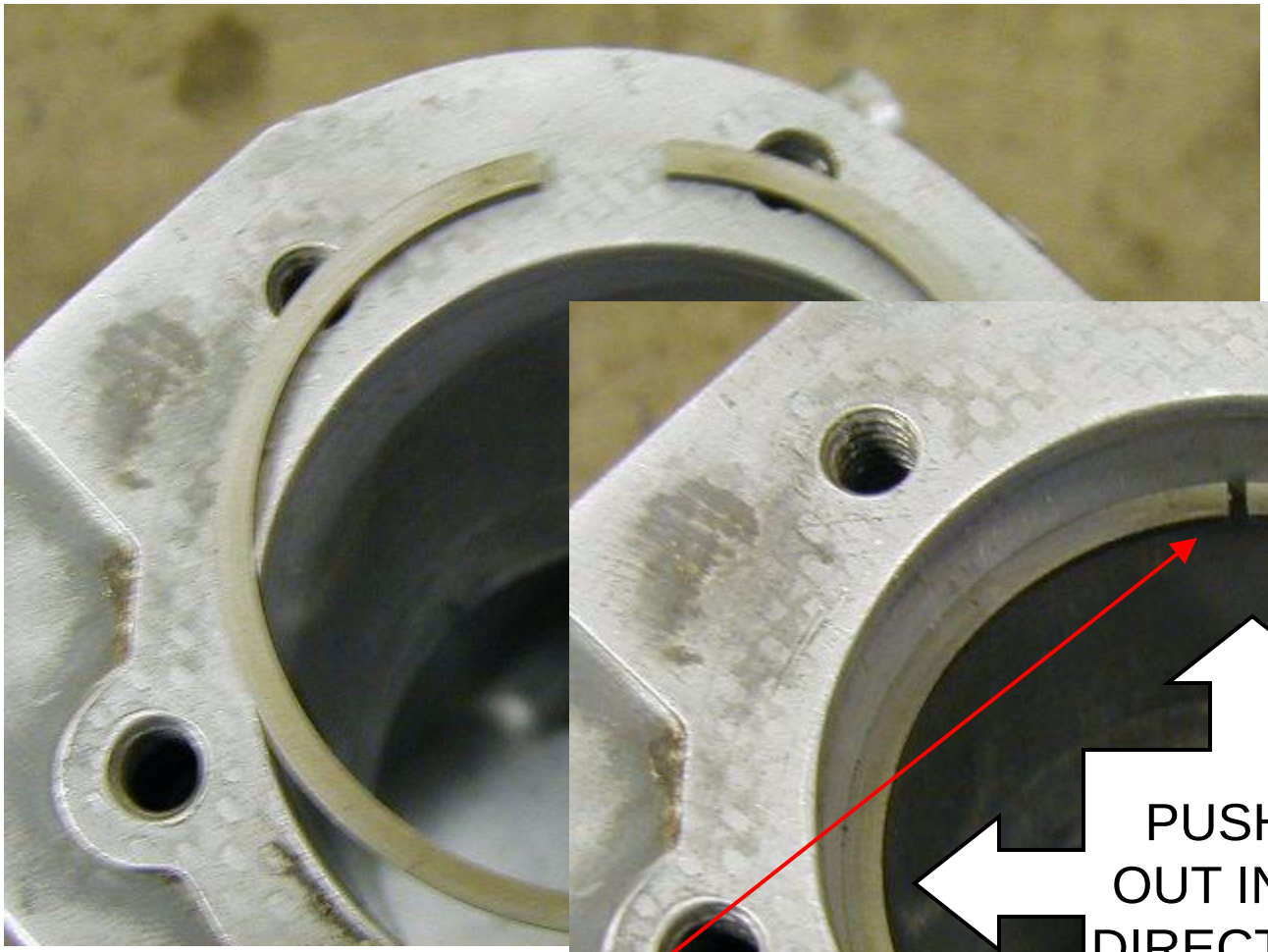
PARTS LIST

- #14 COMPRESSION RINGS
  - SEALS PRESSURE AND VACUUM IN CYLINDER BY PISTON

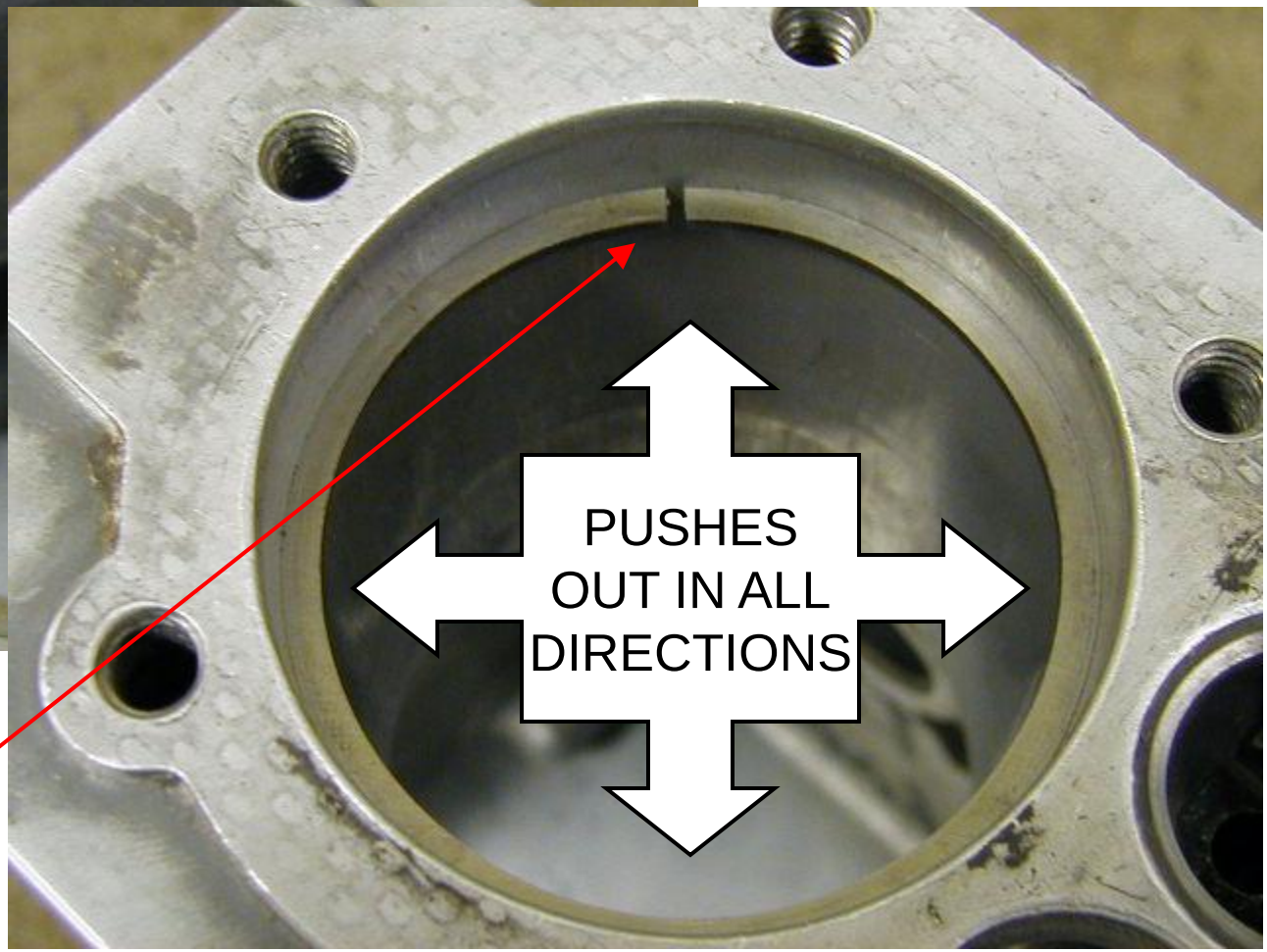




COMPRESSION RINGS



RING OFF OF PISTON TO SHOW CYLINDER FIT



SQUEEZED DOWN INTO CYLINDER

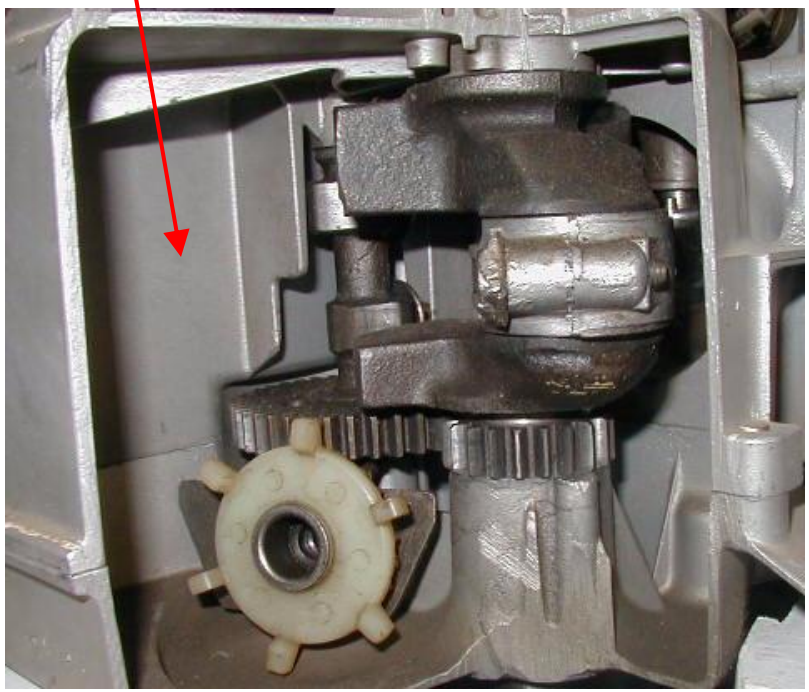
ENGINE NOTES

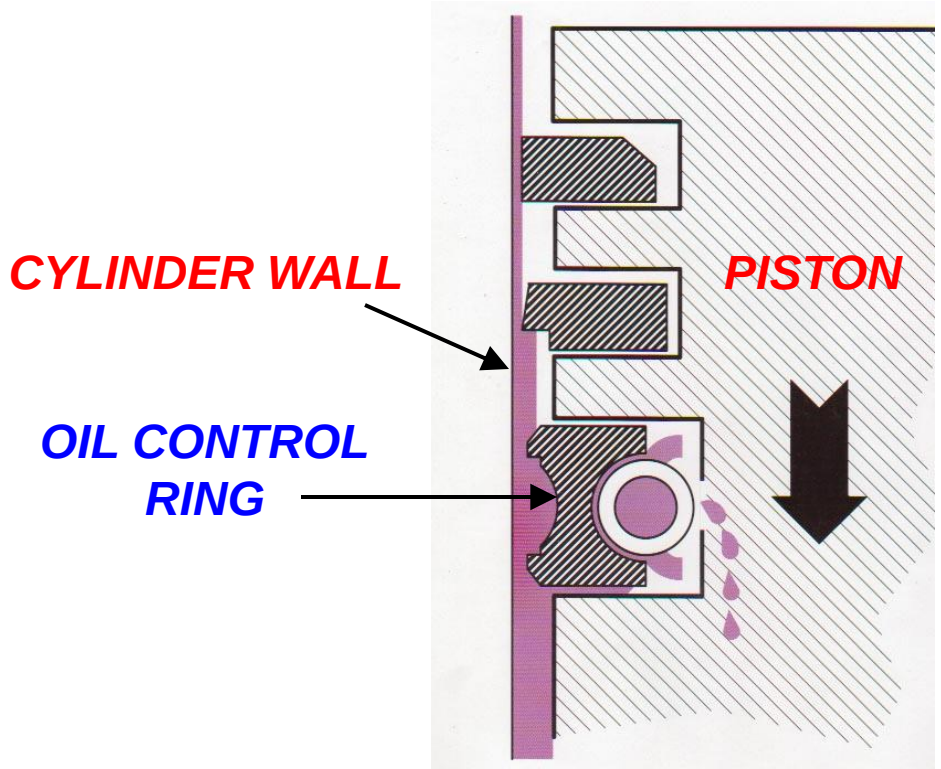
- #18 BLOW BY
  - PRESSURE BEING BLOWN PAST THE RINGS AND PISTON

CRANKCASE

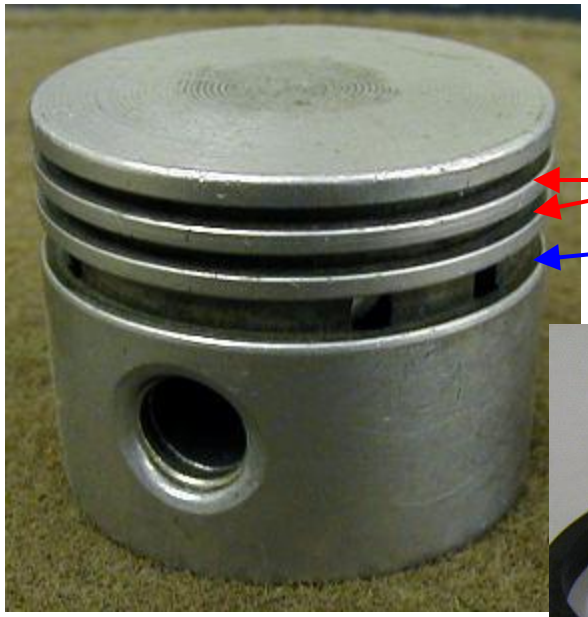
PARTS LIST

- #15 CRANKCASE
  - AREA WHERE THE CRANKSHAFT IS AT
- #16 OIL CONTROL RING
  - SCRAPES EXCESS OIL OFF OF CYLINDER WALL





PISTON AND RINGS



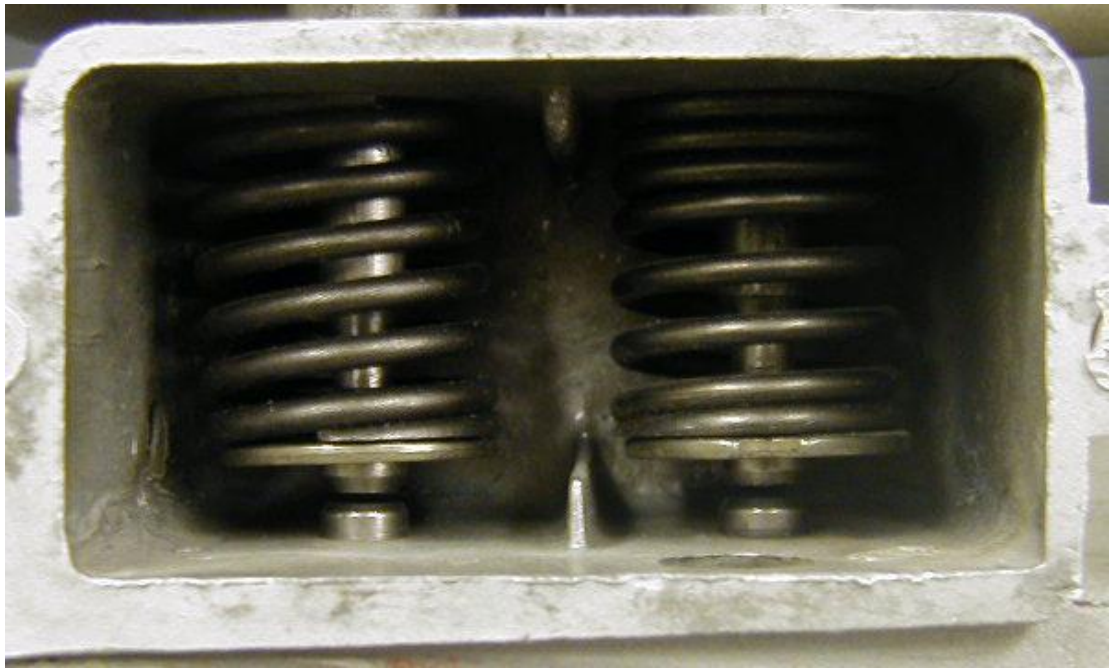
COMPRESSION RING LANDS

OIL CONTROL RING LAND

RINGS INSTALLED ON PISTON

PARTS LIST

- #17 VALVE SPRING
  - – CLOSES VALVE QUICKLY AND TIGHT

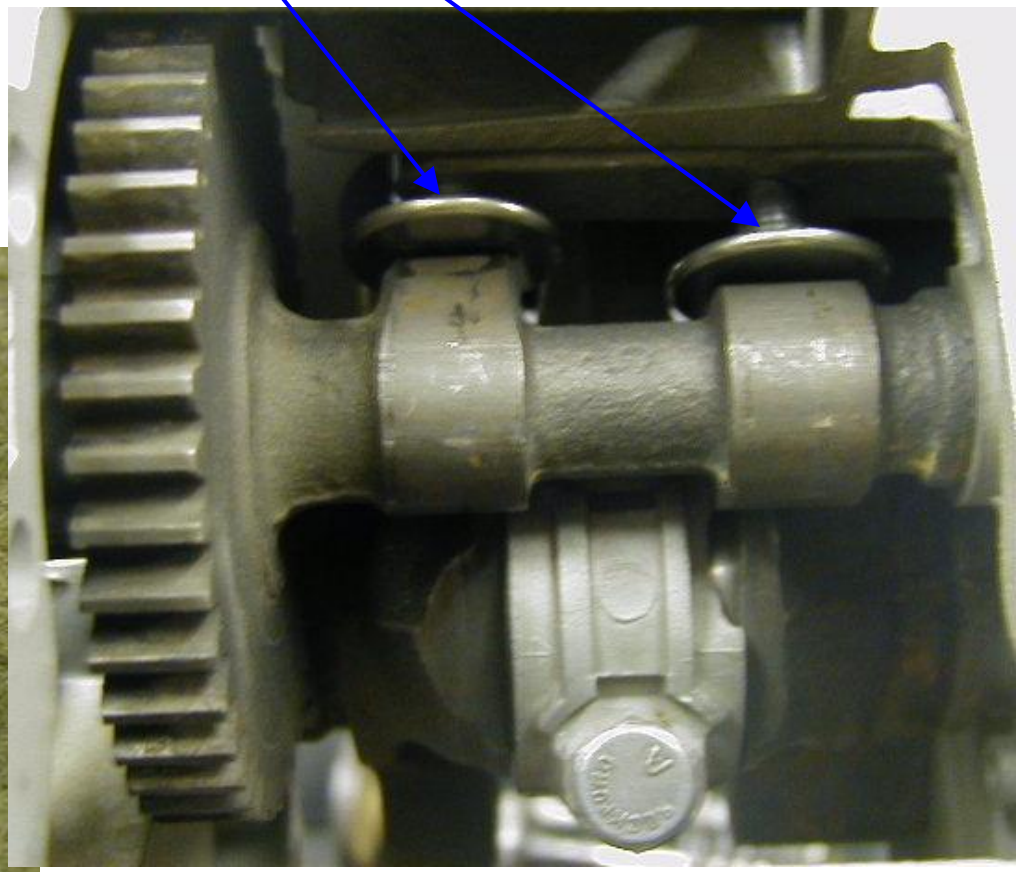


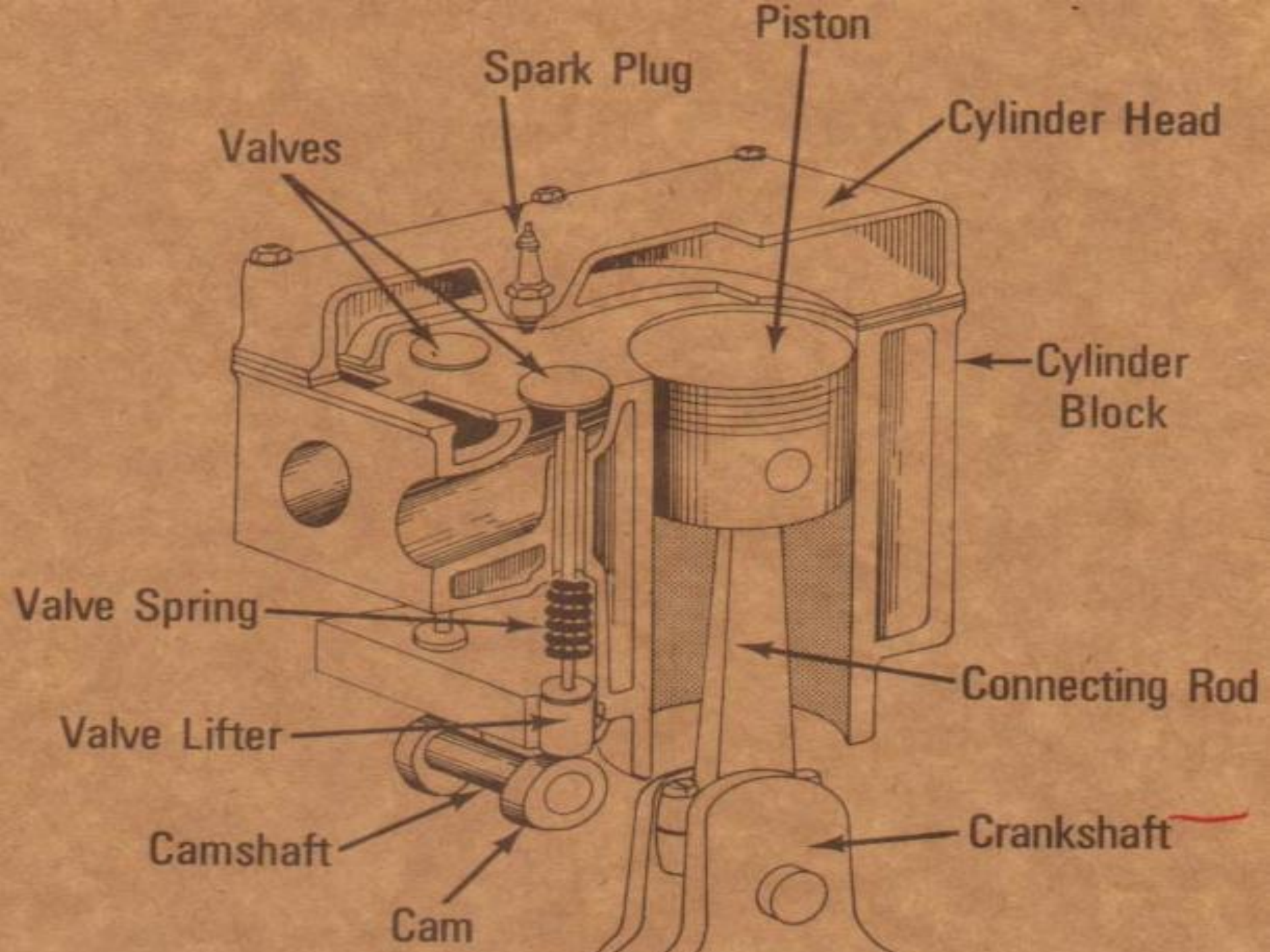
WHAT CLOSES THE VALVES?

CAMSHAFT ALLOWS THE VALVES TO CLOSE. SPRINGS ACTUALLY CLOSE THEM.

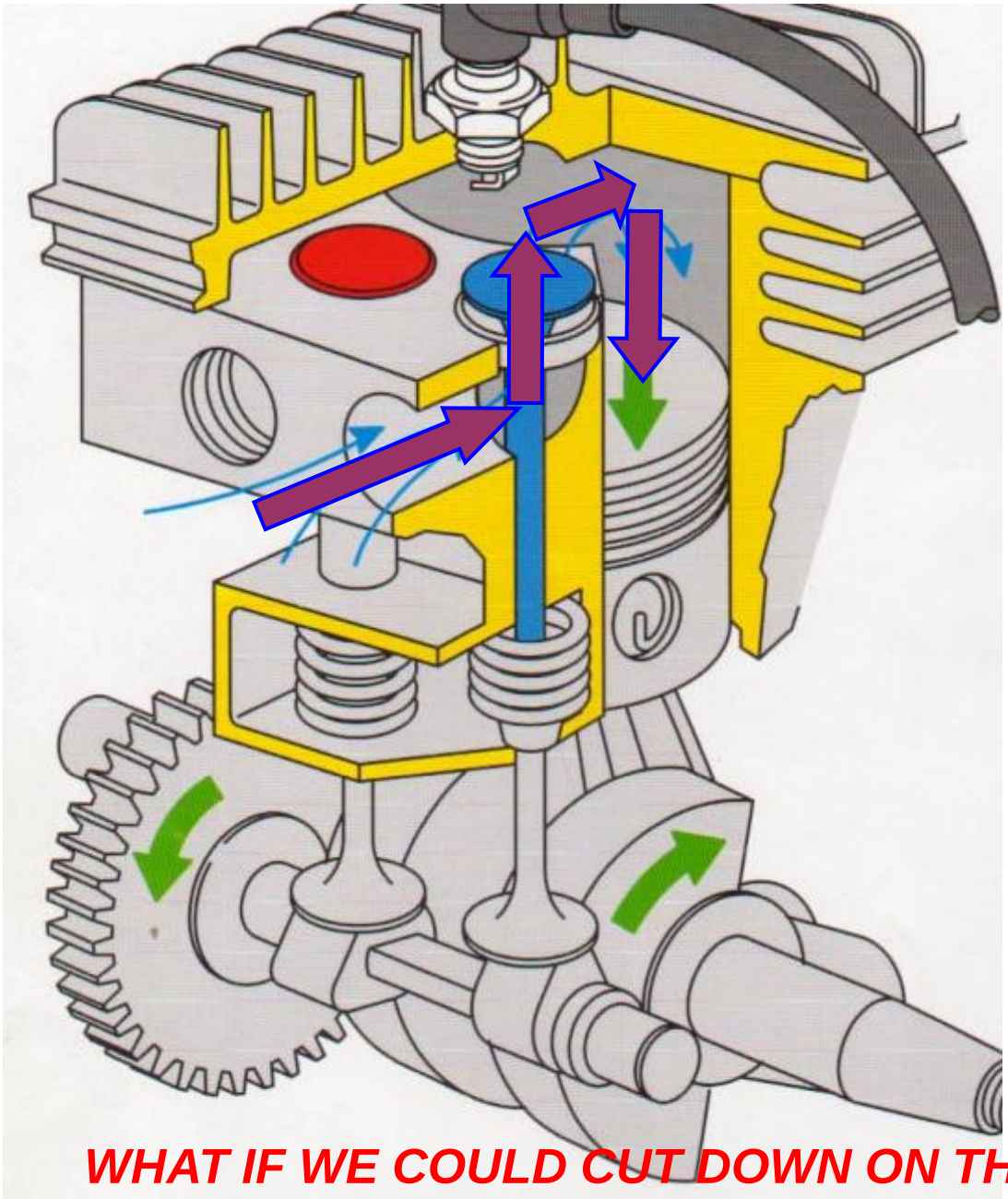
PARTS LIST *LAST PART FOR AWHILE*

- #18 VALVE LIFTER
  - RIDES ON CAMSHAFT TO SPREAD FORCE OUT TO OPEN VALVES




Piston
Spark Plug
Cylinder Head
Valves
Cylinder Block
Valve Spring
Connecting Rod
Valve Lifter
Crankshaft
Camshaft
Cam

FLAT HEAD VALVE TRAIN

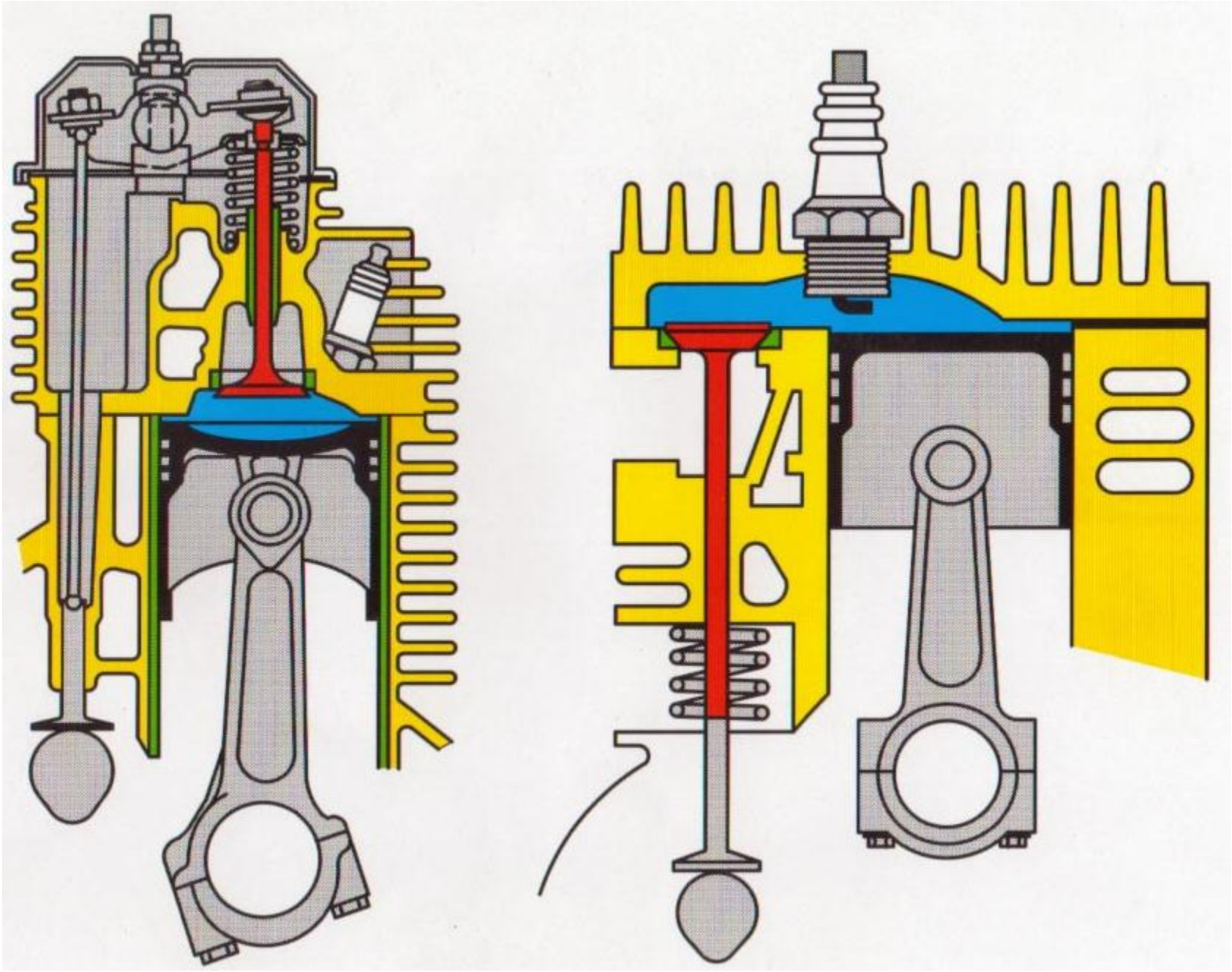


HAVEN'T USED IN CARS FOR SEVERAL YEARS.

THINK ABOUT ENGINE SPEED.
WHAT KIND OF PROBLEM DO WE HAVE WITH THIS DESIGN?

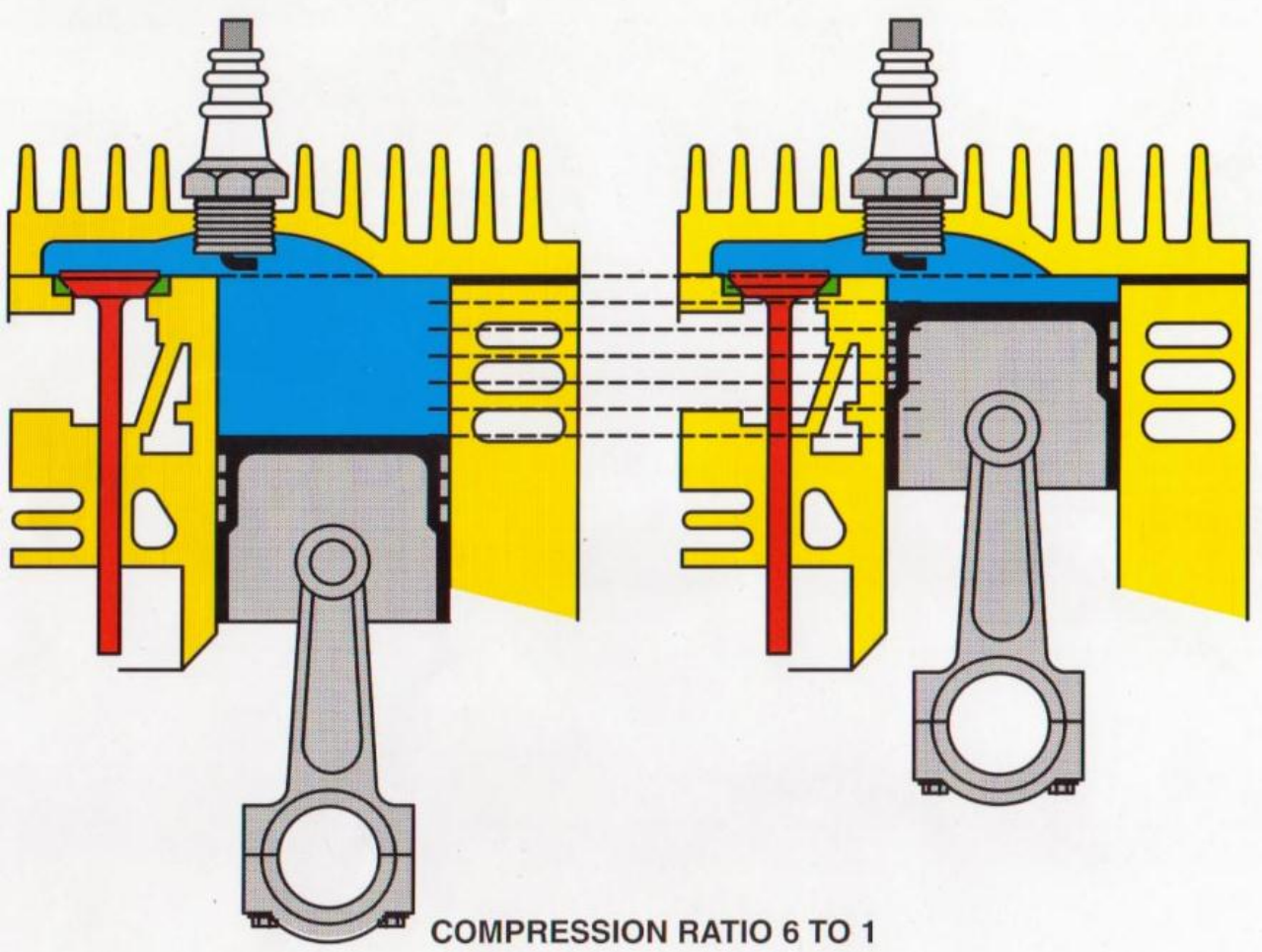
COUNT THE NUMBER OF 90 DEGREE BENDS THE A/F MIXTURE HAS TO GO THROUGH TO GET INTO CYLINDER.

WHAT IF WE COULD CUT DOWN ON THE NUMBER OF BENDS?



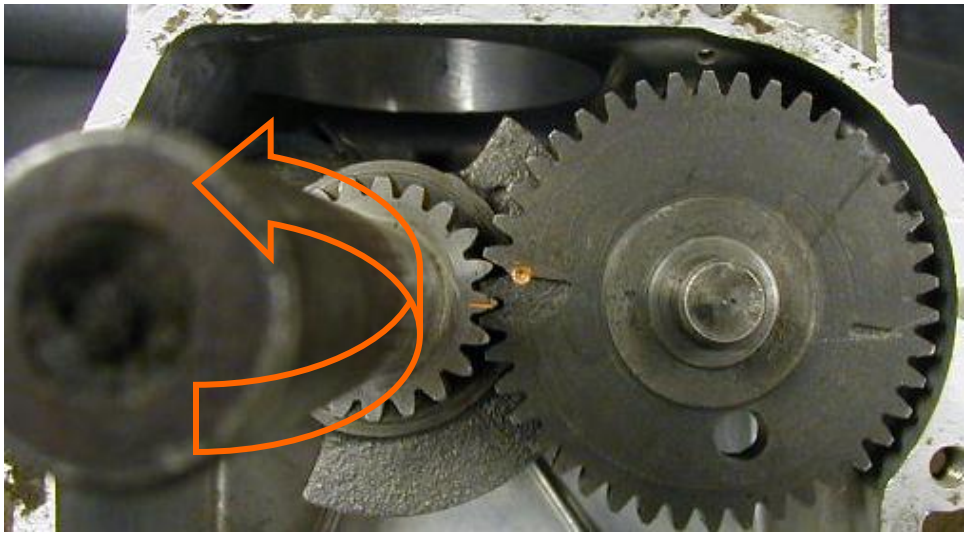
ENGINE NOTES

- #24 COMPRESSION RATIO
  - THE COMPARISON (RATIO) OF HOW MUCH THE PISTON SQUEEZES DOWN THE VOLUME FROM BDC TO TDC



ENGINE NOTES

- #25 CAM TIMING
  - OPENING AND CLOSING THE VALVES AT A PRECISE TIME



WHAT WOULD HAPPEN TO THE VALVES AS A RESULT OF THE THIS?

BOTH VALVES WOULD OPEN TO SOON, AND CLOSE TOO SOON!

ENGINE PROBABLY WOULDN'T RUN OR WOULD BE VERY HARD TO START.

MARKS MUST LINE UP!

INTAKE VALVE CLOSING

- WE CAN LEAVE THE INTAKE VALVE OPEN AFTER THE PISTON REACHES BDC AND GET MORE A/F MIXTURE IN BECAUSE:

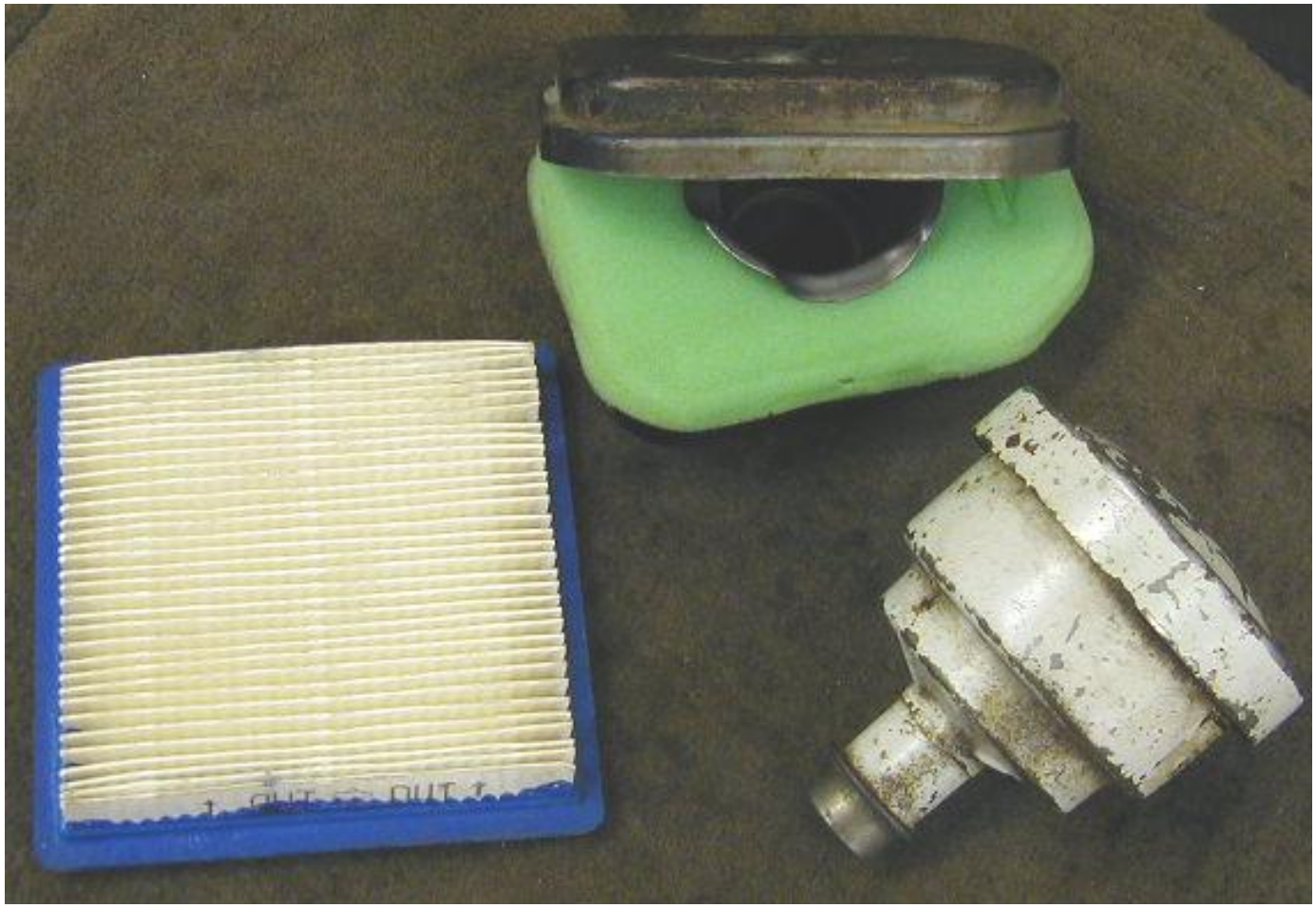
(THIS WILL BE A QUESTION ON YOUR ENGINE TEST)

1. THERE IS STILL A VACUUM WHEN THE PISTON GETS TO BDC. (DIDN'T GET CYLINDER FULL)
2. INERTIA (REMEMBER OUR FOOTBALL PASS PLAY?)

- WE TYPICALLY CLOSE THE INTAKE VALVE AROUND 40 TO 70 DEGREES AFTER BDC (ABDC)

ENGINE PARTS LIST

- #19 AIR FILTER
  - CLEANS AIR BEFORE ENTERING CYLINDER



ENGINE PARTS LIST

- #20 BLOWER HOUSING
  - A. DIRECTS AIR FLOW ACROSS ENGINE TO COOL
  - B. PART OF STARTING SYSTEM ON SOME ENGINES (REWIND)

Here is Your Engine

Model,Type,Code

ENGINE PARTS LIST

- FLYWHEEL MESH GUARD