United States Patent

Bell et al.

[15] **3,691,641**

[45] **Sept. 19, 1972**

[54] **TOOL FOR ESTABLISHING IGNITION TIMING OF A RECIPROCATING INTERNAL COMBUSTION ENGINE**

[72] Inventors: **John M. Bell,** Dearborn; **Robert A. Mooney,** Orchard Lake, both of Mich.

[73] Assignee: **Ford Motor Company,** Dearborn, Mich.

[22] Filed: **March 15, 1971**

[21] Appl. No.: **124,082**

[52] **U.S. Cl.**..**33/181 AT**

[51] **Int. Cl.**...**G01b 3/30**

[58] **Field of Search**..33/180 AT, 181 AT, 180 R, 181 R

[56] **References Cited**

UNITED STATES PATENTS

1,410,432	3/1922	Wallin	33/181 AT
1,545,458	7/1925	Pearson	33/181 AT
2,426,991	9/1947	Emrich	33/181 R
3,131,484	5/1964	Storch	33/181 AT

Primary Examiner—Leonard Forman

Assistant Examiner—Charles E. Phillips

Attorney—John R. Faulkner and Glenn S. Arendsen

[57] **ABSTRACT**

An elongated bar that engages the engine crankshaft for rotation therewith has a pad for contacting a pan rail of the engine block when the number one piston of the engine is at its top dead center position. A pin slidable in the bar then is extended to position a timing plate on the engine block. Tightening the timing plate in this position establishes accurately the location of the plate relative to the number one piston.

5 Claims, 3 Drawing Figures

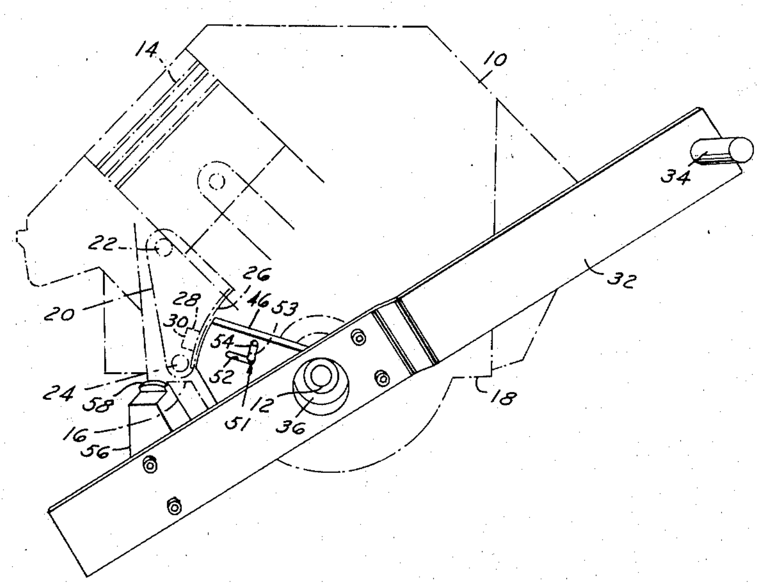


FIG.1

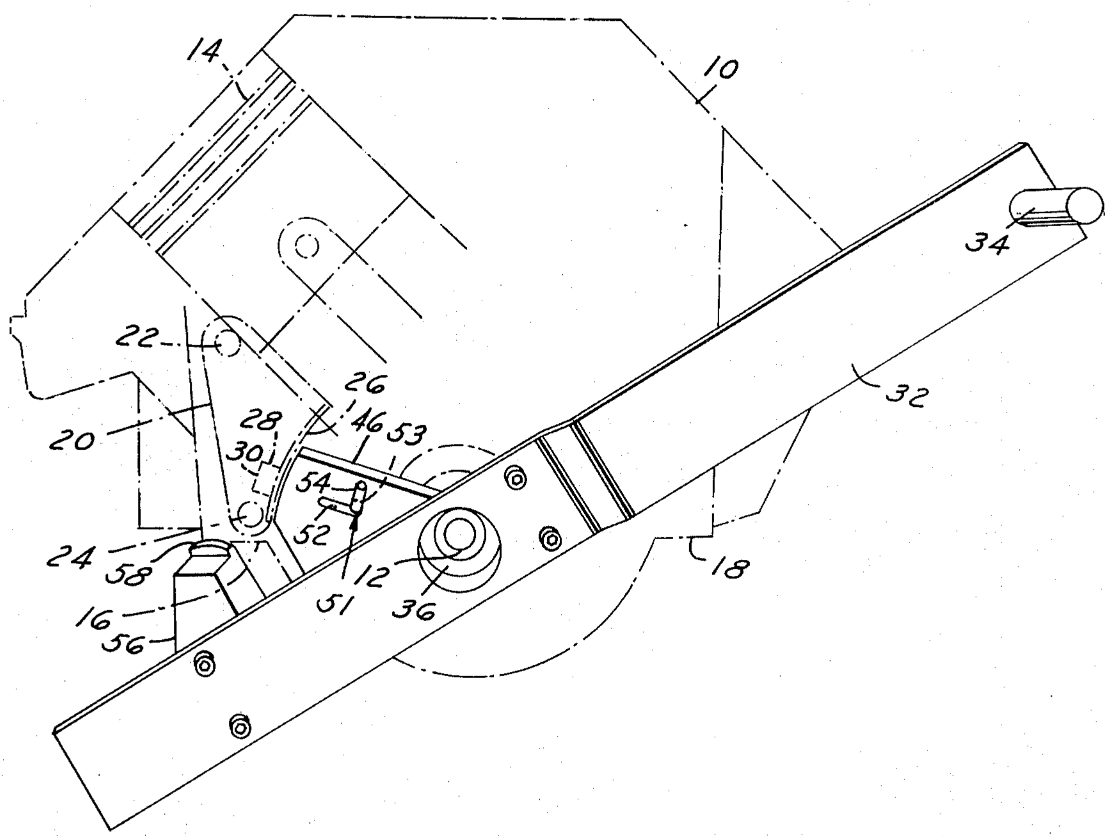


FIG.3

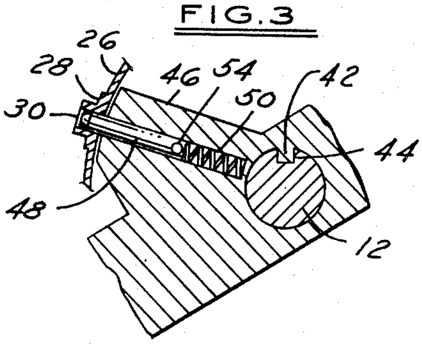
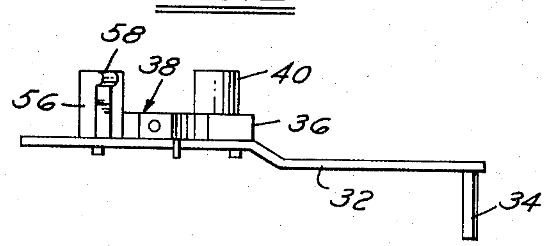


FIG.2



INVENTORS
JOHN M. BELL
ROBERT A. MOONEY
BY
John R. Faulkner
Glenn S. Arendsen
ATTORNEYS

TOOL FOR ESTABLISHING IGNITION TIMING OF A RECIPROCATING INTERNAL COMBUSTION ENGINE

SUMMARY OF THE INVENTION

This application to the subject matter of concurrently filed U.S. Pat. application Mooney et al. Ser. No. 124,080, entitled "Process for Establishing Ignition Timing of Reciprocating Internal Combustion Engine," the entire disclosure of which is incorporated herein by this reference.

Ignition timing of reciprocating internal combustion engines has a considerable effect on vehicle emission levels and extensive research and development has been conducted in recent years to determine optimum timing for all phases of engine operation. The effectiveness of optimum timing of course depends on initial timing settings, however, and prior art techniques of setting initial timing have been found to introduce variations that have a significant effect on emissions.

In typical prior art techniques of setting initial timing, a crankshaft damper or pulley mounted on the projecting portion of the engine crankshaft has at least one scribed mark on its exterior surface that coincides with a timing pointer mounted on the engine block when the number one piston is at its top dead center (TDC) position. Ignition timing is set dynamically at a predetermined engine speed with a strobe light synchronized with the ignition pulse for the number one cylinder. The strobe light is aimed at the timing pointer and its impulses provide a visual indication of the relationship between the pointer and the scribed mark on the crankshaft damper or pulley. Rotating the ignition distributor sets the timing to the desired value.

A source of considerable error in ignition timing has been the assumption that manufacturing tolerances relating to the timing pointer position do not produce significant timing variations. It has been discovered, however, that variations in the position of the pointer permitted by tolerances and assembly practices can shift the entire timing curve by several degrees. Additionally, numerous accessories on the front of the engine introduce paralax errors during strobe light operation, and the proximity of the rotating engine fan plus moving accessory drive belts induces potential human errors.

This invention provides a tool for use in timing a reciprocating internal combustion engine that accurately establishes the position of a timing plate relative to a reference position of an engine piston. The tool can be manufactured economically and used efficiently. For a reciprocating internal combustion engine having an engine crankshaft mounted rotatably in an engine block and having at least one piston connected to the crankshaft for reciprocating movement in the block, the tool comprises a frame member having an engaging device for engaging the frame member with the engine crankshaft. When so engaged, the frame member is rotatable relative to the engine block along with the crankshaft. A pad included on the frame member contacts a surface of the engine block when the frame member and crankshaft have rotated to the point where the reference piston is in a reference position, usually the top dead center position of the number one piston. With the frame member in this position, a locating member is moved into contact with the timing plate which then is fastened tightly to the engine block to establish accurately the relationship between the timing plate and the reference position of the piston.

The frame member typically is an elongated bar that has attached thereto a cylindrical member capable of sliding into and out of engagement with the portion of the engine crankshaft projecting from the front of the engine block. A locking key integral with the cylindrical member slides into a keyway on the crankshaft to connect nonrotatably the frame member to the crankshaft. When so engaged with the crankshaft, the frame member extends laterally across the front of the engine block. The pad usually is attached to the frame member at a location laterally removed from the cylindrical member where the pad contacts the machined surface forming a portion of the pan rail of the block. A handle can be attached to the other lateral end of the frame member to permit easy, manual rotation of the frame member and engine crankshaft. Alternatively, the frame member can be attached to a pneumatic, hydraulic, or electrical machine that automatically rotates the pad into contact with the pan rail. A retractable pin is included in the frame member at a location where extending the pin slides it into contact with a socket in the timing plate when the reference pad contacts the pan rail.

Other machined surfaces of the engine block that are capable of maintaining close tolerances can be contacted by the reference pad although the pan rail, because of its convenience and the high timing accuracy it produces, is preferred. For example, actual tests show that pan rail tolerances of ±0.010 inch from the horizontal crankshaft centerline of a 351 cu. inch V-8 engine produce angular variations in the position of the crankshaft of ±0° 03 feet 37 inches, which translates to lineal variations of ±0.00001 inch of the reference piston from its top dead center position.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevation of a partially assembled V-8 type reciprocating internal combustion engine showing the relationship thereto of the timing plate and the frame member, pad, and locating pin of a tool of this invention.

FIG. 2 is a top view of a tool showing the cylindrical member that engages the frame member with the engine crankshaft.

FIG. 3 is a partial sectional view taken through the locating pin and engaging member of the tool.

DETAILED DESCRIPTION

Referring to FIG. 1, the block **10** of a reciprocating V-**8** type internal combustion engine has an engine crankshaft **12** mounted rotatably therein. Eight pistons are attached in the conventional manner to crankshaft **12** for reciprocating movement in block **10** and the number one piston is represented in the drawing by numeral **14**. The lower side of block **10** contains a pair of longitudinal pan rails **16** and **18** that extend along the lower edges of the block. Pan rails **16** and **18** are machined to receive the engine pan (not shown) that is subsequently attached to the block. An ignition timing plate **20** is attached by two threaded fasteners **22** and **24** to the front of engine block **10**. Plate **20** has a portion **26** that projects outwardly from the engine block and portion **26** has a boss **28** attached thereto to define a locating socket **30**.

The tool of this invention comprises a frame member **32** that is in the shape of an elongated bar. A projecting handle **34** is attached to one end of the frame member and an engaging member **36** is attached to its central portion. Engaging member **36** includes a plate **38** having a hollow cylindrical member **40** projecting inwardly therefrom (FIG. 2). The opening in cylindrical member **40** fits on the projecting end of crankshaft **12** and has an integral key **42** that slides into a corresponding keyway **44** on the crankshaft to nonrotatably attach the frame member to the crankshaft (FIG. 3).

As shown best in FIGS. **1** and **3**, the bar includes a portion **46** that projects radially from cylindrical member **40** and terminates just short of timing plate **20** when cylindrical member **40** engages the engine crankshaft. A pin **48** is located slidably in projecting portion **46** and is spring loaded by a spring **50** to an extended position. The axially outer face of projecting portion **46** contains an L-shaped groove **51** having one leg **52** extending parallel to the axis of pin **48** and the other leg **53** extending at right angles thereto. A stud **54** attached to the inner end of pin **48** slides in leg **52** when the pin is extended. Moving stud **54** into leg **53** locks pin **48** in its retracted position.

A pad member **56** is attached to the lower end of frame member **32**. Pad member **56** projects inwardly from the frame member and has a machined pad **58** on the upper side of its innermost corner.

The tool is used in establishing the ignition timing of a reciprocating internal combustion engine in the following manner. Plate **20** is attached loosely to the front of the engine block and an operator slides cylindrical member **40** onto the exposed end of the engine crankshaft so that key **42** slides into crankshaft keyway **44**, thereby locking the tool nonrotatably to the crankshaft. With pin **48** in a retracted position, the frame member **32** is rotated in a clockwise direction in FIG. **1** until pad **58** contacts engine block pan rail **16**. The dimensions of frame member **32** and pad member **56** are determined so that when pad **58** contacts the pan rail **16**, the number one piston **14** of the engine is at its top dead center position.

Pin **48** is extended to slide into socket **30** of timing plate **20** and the timing plate then is fastened tightly to the engine block. Pin **48** then is retracted and locked in its retracted position by sliding stud **54** up into the leg **53** of slot **52**. Frame member **32** is withdrawn from the engine which continues along the assembly line. A vibration damper having at least one mark on its cylindrical surface is installed on the front of the crankshaft so the movement of the mark past the timing plate relative to the moment an ignition pulse is supplied to the number one cylinder can be sensed during subsequent dynamic engine timing.

Thus this invention provides a tool that accurately and efficiently establishes the relationship of a timing plate to the piston position of reciprocating engines. The timing plate subsequently can be used to determine dynamic ignition timing by a variety of techniques including the use of the conventional strobe light. Once the dimensions of the tool are established, it can be used to set timing plate position at any point on the assembly line after crankshaft installation.

We claim:

1. A tool for use in establishing ignition timing of a reciprocating internal combustion engine having an engine crankshaft mounted rotatably in an engine block and at least one piston connected to said crankshaft for reciprocating movement in said block comprising;
   - a frame member,
   - engaging means on said frame member for mounting said frame member on said engine crankshaft in a predetermined position, said frame member being rotatable relative to said block with said crankshaft when mounted on said crankshaft,
   - abutment means on said frame member for contacting said engine block when said frame members and crankshaft rotation has moved said piston to a reference position,
   - said engaging means comprises a cylindrical member fitting on an end of said engine crankshaft,
   - a locking means for nonrotatably connecting said frame member to said crankshaft, and
   - a pin means on said frame member for positioning a timing plate on said engine block when said piston is in said reference position.

2. The tool of claim **1** in which the abutment means comprises a pad member for contacting a machined surface of said engine block when said piston is in said reference position.

3. The tool of claim **2** in which the pad member contacts a pan rail of the engine block when said piston is in said reference position.

4. The tool of claim **3** comprising spring means for spring loading said pin means toward and extended position where said pin means engages the timing plate and latch means for maintaining said pin means in a retracted position.

5. The tool of claim **1** comprising spring means for spring loading said pin means toward an extended position where said pin means engages the timing plate and latch means for maintaining said pin means in a retracted position.

* * * * *