AMERICAN BOSCH
PRODUCTS

MAGNETO TIMING

Generally speaking, all magnetos are timed so that they will fire the clyinder under compression at top dead center with the timing arm in the fully retarded position. While this method usually is satisfactory, it is nevertheless true that, under certain conditions, the above procedure *will not always* procure the desired results.

It is, therefore, in order to explain the timing of a magneto in detail and point out definitely the importance of observing certain items in order that best results may be obtained under all conditions.

1—Four Cylinder Four Cycle Motor

Magneto driven at crank shaft or engine speed.

A four cylinder four cycle engine produces two explosions per revolution of the crank shaft and it will therefore be necessary to run the conventional four cylinder magneto which delivers two sparks per revolution of its armature (or one every 180° travel) at engine speed.

The relation between engine travel and magneto travel is consequently:

$$360° \text{ to } 360°$$

$$\frac{360}{360} = \frac{1}{1} \text{ or 1 to 1}$$

Since the magneto is driven at engine or crank shaft speed, it must follow that the angular relation between the timing movement of the interrupter housing and the angular movement of the crank shaft is the same. In other words, when the engine flywheel has traveled 35°, the magneto armature has also moved 35°. If then, this particular magneto has a 35° timing range, the actual spark can be made to occur anywhere from top dead center to 35° ahead of top dead center, provided the magneto was originally timed top dead center in full retard.

Therefore, if you require *more* than 35° advance, you must time the magneto *ahead* of dead center at full retard to an amount equivalent to the number of degrees which you require in addition to the 35° which the magneto provides.

If you are timing a slow speed, high compression engine, it might be advisable to set the magneto from 5° to 10° *past* dead center at full retard, thus sacrificing the number of degrees of the magneto advance obtainable.

2—Six Cylinder Four Cycle Motor with Magneto Running Faster than Engine Speed

A six cylinder four cycle engine produces three explosions per revolution of the crank shaft and it will, therefore, be necessary to run the conventional six cylinder magneto which delivers two sparks per revolution (or one every 180° travel of the armature) at a speed to produce three sparks during that period. In other words, it must travel through 180° +180° + 180° or 540° which is equivalent to 1½ engine speed.

The relation between engine travel and magneto travel is consequently:

$$(360° \times 1.5) \text{ to } 360°$$

$$\text{or } 540 \text{ to } 360$$

$$\text{or } \frac{540}{360} = \frac{1.5}{1} \text{ or } 1\tfrac{1}{2} \text{ to } 1$$

When the magneto is not driven at engine speed, its timing range, as measured at the engine crank shaft, is changed accordingly.

Due to the fact that the magneto speed is 1½ times engine speed, it must follow that the angular relation between the timing movement of the interrupter housing and the movement of the crank shaft on the engine, must also be 1½ to 1. As an example, when the magneto has traveled 35°, the engine flywheel has only traveled 23°. This is explained as follows:

$$\frac{35}{1.5} = \frac{350}{15} = \frac{70}{3} = 23° \text{ (Disregarding the minutes)}$$

Again, then, if this particular magneto has a 35° timing range, the actual spark can be made to occur anywhere between top dead center and 23° ahead of dead center, provided magneto was originally timed top dead center in full retard. Therefore, if you require *more than the* 23° advance, you must time the magneto *ahead* of dead center in full retard, to an amount equivalent to the number of degrees which you may require *in addition to the* 23°.

3—Two Cylinder Four Cycle Motor (Firing at Equal Intervals)

Magneto driven at cam shaft or ½ engine speed.

A two cylinder four cycle engine produces one ex-

plosion per revolution of the crank shaft, and it will therefore be necessary to run the conventional two cylinder magneto which delivers two sparks for each revolution of its armature (or one every 180° of travel) at a speed to produce one spark during that period, or at ½ engine speed.

In other words, it must travel:

$$360° \times \tfrac{1}{2} \text{ to } 360°$$

$$\text{or } 180° \text{ to } 360°$$

$$\text{or } \frac{180}{360} = \frac{1}{2} \text{ or } \tfrac{1}{2} \text{ to } 1$$

The angular relation between the timing movement of the interrupter housing and the angular movement of the crank shaft is therefore the same or ½ to 1. In other words, when the magneto armature has traveled 35°, the engine crank shaft is rotated twice that amount or 70°. If, then, this particular magneto has a 35° timing range, the actual spark can be made to occur anywhere from top dead center to 70° ahead of top dead center, provided the magneto was originally timed top dead center in full retard.

Therefore, if you require *less* than 70° advance, you must time the magneto *past* dead center at full retard to an amount equivalent to the number of degrees which you require. Obviously, the better method is to use a magneto with a 20° timing range.

Another alternative would be to run the magneto at crank shaft or engine speed. Due to the fact that the magneto delivers two sparks per revolution of its armature where only one spark is required, it must follow that one spark must alternately be dissipated in the engine exhaust.

Either procedure is, however, frequently objectionable. The former on account of hard starting (especially when no impulse coupling is employed) which is due to the ½ engine speed at which the magneto is running—and the latter is often unsuitable due to the waste spark causing an explosion through the carburetor, depending on the valve setting of the particular engine.

Therefore another method has been developed which is known as the 4/2 magneto application.

Such a magneto is a four cylinder instrument driven at engine or crank shaft speed with either two alternating terminals of its distributor entirely eliminated or two adjacent distributor terminals bridged and led to ground through a safety gap.

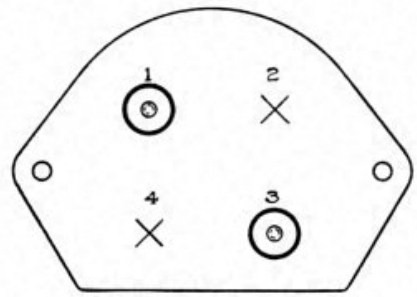
The first mentioned magneto uses *one cam* only in its interrupter housing, while in the latter one two cams must be employed. The latter type is used on two cylinder four cycle engines which fire at unequal intervals similar to that explained in chapter number 4.

A four terminal two pole magneto for use on two cylinder four cycle engines, magneto running at crank shaft speed. Engine is fired every 360°. High tension terminals 2 and 4 are omitted and the interrupter housing of this magneto *has only one cam* to provide only one spark for every revolution of the armature.

The relation between engine travel and magneto travel is, therefore:

$$360° \text{ to } 360°$$

$$\frac{360}{360} = \frac{1}{1} \text{ 1 to 1}$$



4/2 360° Magneto

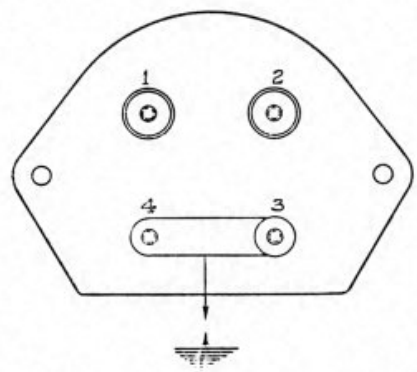
4—Two Cylinder Four Cycle Motor (Firing at Unequal Intervals)

A four terminal two pole magneto for use on two cylinder four cycle engines on which explosions occur at unlike intervals, namely 180° and 540°. Therefore high tension terminals 3 and 4 are connected together, through the safety gap, to ground and the interrupter housing of such a magneto must have two cams to provide two working sparks for every other revolution of the armature.

The relation between magneto degrees and engine degrees is consequently:

$$360° \text{ to } 360°$$

$$\frac{360}{360} = \frac{1}{1} \text{ 1 to 1}$$



4/2 180° Magneto

5—Three Cylinder Four Cycle Motor with Magneto Running Slower than Engine Speed

A three cylinder four cycle engine produces three explosions for every two revolutions of the crank shaft. It will, therefore, be necessary to run the conventional three terminal magneto which delivers two sparks per revolution (or one every 180° travel of the armature) at a speed to produce three sparks during that period (720° of engine travel). In other words, the magneto must travel 180° + 180° + 180° or 540° during the same time that the engine crank shaft travels 720°.

The relation between engine travel and magneto travel is consequently:

$$\frac{540}{720} \text{ or } \frac{.75}{1} \text{ or } \tfrac{3}{4} \text{ to } 1$$

When the magneto is not driven at engine speed, its timing range, as measured at the engine crank shaft, is changed accordingly.

Since the magneto speed is ¾ engine speed, it must follow that the angular relation between the timing movement of the interrupter housing and movement of the crank shaft on the engine, must also be ¾ to 1. In other words, when the engine flywheel has moved 35°, the armature has actually moved 46°. This is explained as follows:

$$\frac{35}{.75} = \frac{3500}{75} = 46°$$ (We have disregarded the minutes)

Again, then, if this particular magneto has a 35° timing range, the actual spark can be made to occur anywhere within this range, that is, between top dead center and 46° ahead of dead center (provided magneto was originally timed top dead center in full retard). Therefore, if you require *less* than the 46° advance, you must time the magneto *past* dead center in full retard to an amount equivalent to the number of degrees which you may require *less* than the 46°.

6—Standard Magneto Timing Instructions

The following instructions are for general purposes only and apply principally to variable ignition.

FOR MOST EFFICENT OPERATION OF THE INDIVIDUAL ENGINE, ALWAYS FOLLOW THE IGNITION TIMING INSTRUCTIONS ISSUED BY THE MANUFACTURER OF THE ENGINE.

When fixed spark ignition is used, the timing must be done by the piston in a position 15° to 40° before top dead center (according to maker's specifications) to procure maximum efficiency. Correct timing as recommended by the engine manufacturer, is generally indicated on the flywheel. ALWAYS FOLLOW ENGINE MAKER'S INSTRUCTIONS.

General Instructions

Rotate the engine crank shaft until number 1 cylinder (in automobile practice this is the cylinder nearest the radiator) is exactly on top dead center of the compression stroke, and maintain the piston in this position. Next secure the magneto to the bracket or support provided for on the engine and place the timing arm of the interrupter housing in the fully retarded position.

Now remove the distributor plate and the interrupter housing cover so that the distributor brush as well as the interrupter contact points may be observed.

The armature should then be rotated by hand in the direction in which it is to be driven until the platinum interrupter contacts are just about to separate, which occurs when the interrupter lever begins to bear against one of the steel interrupter cams.

Hold the armature in that position while you connect the magneto drive to the engine and take due care that the piston of No. 1 cylinder remains exactly on top dead center. The installation is completed by replacing the interrupter housing cover and distributor plate and connecting the cables between the magneto and spark plugs. Obviously, spark plug of No. 1 cylinder must be connected to the distributor terminal which is in contact with the distributor brush and the other wires must be connected in their proper sequence (depending on the rotation of the magneto) in accordance with the firing order of the cylinders.

To time a magneto equipped with an impulse coupling, set No. 1 cylinder on top dead center position of the compression stroke, and revolve the armature until the coupling is released from the arrester plate; when this occurs, rotate the armature backward until the interrupter lever again crosses the cam and then rotate it in the proper direction until the points are just beginning to open. After this has been done, proceed in the same manner as you would with a magneto not equipped with an impulse coupling.

7—American Bosch Impulse Coupling Characteristics

When a magneto is equipped with one of our Type IC-200 or 250 Series Impulse Couplings, it must be borne in mind that the coupling construction incorporates three variables which permit any desired degree of advance.

The American Bosch Type IC coupling is described in detail in Section 3150 of the American Bosch Serv-

ice Manual, and we recommend that you familiarize yourself with these details so that you may thoroughly understand the following.

The three variables are:

1. The total spring windup controlling the impulse movement or the movement of the coupling through the angle "A" indicated on Figure No. 1, which angle is measured from the point of arrester plate engagement to the point of arrester plate release (through the cam action).

2. The angle "B" indicated on Figure No. 1, or the coupling movement from the time of arrester plate engagement to the edge of the pole shoe.

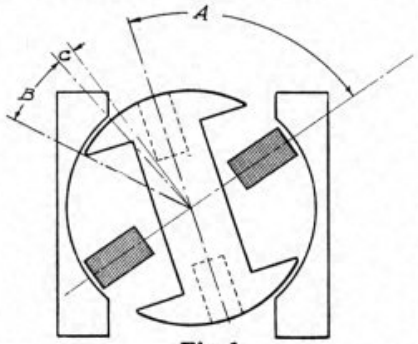


Fig. 1

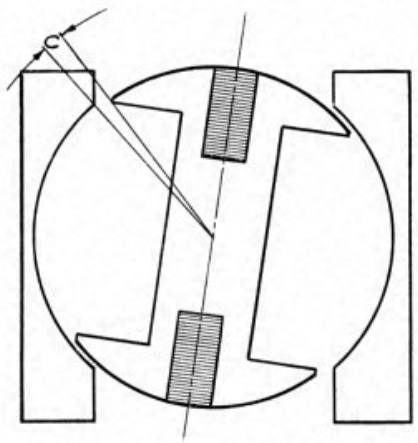


Fig. 2

3. The armature edge distance or the angle "C" indicated on Figure No. 2 which is the angular distance through which the armature has traveled away from the edge of the pole shoe before the spark occurs.

Therefore, if the magneto has been timed to the engine so that the *impulse spark* will occur at top dead center, the *actual* spark advance obtained (at an engine speed at which no impulsing occurs) will be equivalent to the number of degrees expressed by the angle A—(B + C).

For example, if A = 60°, B = 25°, C = 5° the actual spark advance will be 60°—(25° + 5°) or 30°.

It should be noted that, while the coupling is impulsing (at slow engine speed), the magneto timing range or its interrupter housing movement has practically no influence on the timing. As soon as an engine speed is obtained however, which prevents the coupling from impulsing, the timing range is affected by the movement of the interrupter housing in identically the same manner as if no coupling were affixed to the magneto at all.

Obviously it is always advisable to select a Type IC American Bosch impulse coupling which gives the proper advance necessary for the particular engine. If, for any reason, you must reduce the advance of any particular coupling installed on a magneto (without making a coupling change), it is necessary to time the magneto *by the running spark* (with timing arm in fully advanced position) as many degrees *ahead* of top dead center as may be required and totally disregard the impulse spark.

8—Timing a Magneto Equipped with American Bosch Impulse Coupling

When a magneto has been equipped with American Bosch Type IC impulse coupling, two methods may be followed in timing the instrument to the engine.

1st. By disregarding the coupling entirely and timing the instrument at top dead center of the compression stroke, as previously explained.

2nd. By timing the magneto so that the *impulse spark* occurs at top dead center.