To all whom it may concern:

Be it known that we, HARRY A. SUTTON and CHARLES LEIGH PAULUS, citizens of the United States, residing at Dayton, in the county of Montgomery and State of Ohio, have invented certain new and useful Improvements in Synchronizing Gun Controls, of which the following is a specification.

This invention relates to synchronizing gun control, the broad object in view being to provide mechanical means for automatically rotating one section of the impulse generator shaft in relation to the other section thereof for automatically timing the firing impulses of the Nelson gun control to compensate for any increase or decrease in the rotational speed of the engine shaft and propeller in order that the bullets will pass between the blades of the propeller and not damage the same.

With the above and other objects in view, the invention consists in the novel construction, combination and arrangement herein fully described, shown and claimed.

In the accompanying drawings:

Figure 1 is a view partly in side elevation and partly in section showing the invention in its relation to a machine gun and the mechanism of an internal combustion engine.

Figure 2 is an enlarged elevation of the impulse generator showing the relation of the two sections of the impulse generator shaft, and the means for causing a relative rotative movement of the shaft sections.

Figure 3 is a section through the same taken at a right angle to Figure 2.

Figure 4 is a diametrical section through one of the sections of the impulse generator shaft.

Referring primarily to Figure 1, 1 designates the housing of the impulse generator in which is the generator shaft 2, having thereon a cam 3 having two humps or raised portions which serve to impart motion to a tappet 5, the shaft 2 being driven by means herein after described.

The tappet 5 imparts motion to a two armed rocker lever 6 fulcrumed at 5 on the housing and connected by an impulse cable section 7 to a rocker arm 8 on the face of the machine gun conventionally shown at 9.

Another impulse cable section 10 extends from the arm 8 to the trigger motor lever 11 of the trigger motor 12 mounted on the side of the gun. It may be noted at this point that the lever 11 is pressed outwardly or to the right in Figure 1 by a plunger operating spring within the trigger motor housing so that the cable sections 7 and 10 are kept under tension.

The means for throwing the gun into and out of operation comprises an operating control lever 13 fulcrumed on a bracket 14, fastened to the pilot's control stick 15. A Bowden wire control cable 16 is connected at one end to the lever 13 and passes through a casing 17 into a tubular extension 18 of the impulse generator housing 1, where said cable is attached to a plunger 19 normally pressed against the rocker lever 5 by means of a spring 20 within the housing 18. The plunger 19 has a beveled extremity adapted to ride in contact with the adjacent inner face of the rocker lever 5. When the plunger lever 19 is in the position shown in Figure 1, it holds the rocker lever 5 in such a position that said lever is not affected by the tappet 4, which can reciprocate without firing the gun. When, however, the plunger 19 is retracted by the operation of the control lever 13, the tappet 4 operates the rocker lever 5 in one direction, while the spring bearing against the trigger motor lever 11 causes the return movement of the rocker lever. Therefore as long as the plunger 19 is retracted the firing operation of the gun continues. When the operator releases the lever 13 the plunger 19 is pushed behind the rocker lever 5 and the firing operation ceases.

Referring now to Figures 2, 3 and 4, it will be seen that the impulse generator shaft 2 comprises two sections which may be hereinafter termed as the upper section 2 and the lower section 2'. The lower section 2' is larger than the adjacent end of the upper section 2 so as to fit over the adjacent end of the section 2 as illustrated in Figures 2 and 3. The section 2 is formed at opposite points with inclined cam ways 21 and the adjacent interfitting end of the shaft section 2 is likewise formed in opposite sides thereof with inclined cam ways 22, the same being inclined reversely to the cam ways 21 as indicated in Figure 3. Relative endwise movement of the shaft sections 2 and 2' is limited by means of a split washer or key 23 inserted in a groove in the reduced end portion 24 of the shaft section 2.

A slidable sleeve 25 surrounds both of the interfitting end portions of the shaft sections 2 and 2' and is normally held by means of an encircling coil spring 26 against a shoul-
der 27 of the shaft section 2 as shown in Figure 2. Pins or projections 28 carried by the sleeve 25 operate in the cam ways 21 and 22 in the shaft sections 2 and 2′ as best shown in Figure 2 so that movement of the sleeve 25 along the shaft ends causes one shaft section to be rotated in relation to the other shaft section, this being done to change the lead of the firing mechanism as the speed of the propeller of the aircraft is increased or decreased.

The shaft section 2 has a portion thereof enlarged and formed with a slot 29 in which two centrifugal governor arms 30 are mounted on pivots 31 as shown in Figure 3. The arms 30 carry at their outer ends weights 32 fastened thereto by rivets 33 or equivalent means. The arms 30 have camming portions or extensions 34 which bear against the rounded adjacent edge of the sleeve 25. As the speed of the propeller and engine shaft increases, the weighted ends of the governor arms 30 move outwardly and cause the camming portions 34 to press the sleeve 25 downwardly, compressing the spring 36. As the speed of the engine and propeller decreases, the weighted arms 30 are moved toward their normal position by the action of the spring 36 on the sleeve 25. Thus the relative ratio of position of the shaft sections 2 and 3 is automatically varied in accordance with the speed of rotation of the engine shaft and propeller of the aircraft.

The shaft section 2′ is shown as formed with a flange 35 to enable it to be secured by suitable fastening means to a corresponding coupling flange 36 on one end of an impulse generator drive shaft 37. The shaft 37 is journaled in bearings in a housing 38 and is driven from a section 39 of the cam shaft drive shaft of the engine (not shown) by means of beveled gears 40 and 41. The parts 39 and 41 are contained in a housing 42, the housings 38 and 42 being connected together in any suitable way.

The construction above described provides a reliable mechanical means of producing, controlling, or timing the firing impulses which are synchronized with the propeller, causing the trigger mechanism of the gun to operate so as to fire through the plane of rotation of the propeller. These impulses fire the gun only when the propeller is in such a position that the projectile or bullet will miss the propeller blades when passing through the plane of the propeller's 15 rotation.

The mechanism has been designed to eliminate the lag which occurs in other gun control systems; that is, the time that elapses between the instant the impulse is produced and the firing of the gun. The reduction of this lag reduces the dispersion of the shots, confining them to a small arc and permitting the use of the gun through a wide propeller speed range.

We claim:

1. In synchronizing gun control, rotary impulse generator shaft embodying terminally inter-fitting sections having reversely inclined cam ways, and a centrifugally controlled member engaging said cam ways to vary the relationship between said sections.

2. In synchronizing gun control a rotary impulse generator shaft embodying terminally inter-fitting sections having reversely inclined cam ways, and a centrifugally controlled spring pressed member engaging said cam ways to vary the relationship between said sections.

3. In synchronizing gun control, a rotary impulse generator shaft embodying terminally inter-fitting sections having reversely inclined cam ways, and a centrifugally controlled sleeve sidable over the inter-fitting portions of said sections and having a projection operating in the cam ways thereof to effect a relative rotative movement of the shaft sections.

4. In synchronizing gun control, a rotary impulse generator shaft embodying terminally inter-fitting sections having reversely inclined cam ways, means for preventing relative endwise movement of said sections, and a centrifugally controlled member engaging said cam ways to vary the relationship between said sections.

HARRY A. SUTTON, CHARLES L. PAULUS.