REMEDIES FOR MACHINE GUN MALFUNCTIONS

(ARMAMENT SECTION REPORT)

Prepared by Charles Leigh Paulus
Engineering Division, Air Service
McCook Field, Dayton, Ohio
November 21, 1924
CERTIFICATE: By direction of the Secretary of War the matter contained herein is published as administrative information and is required for the proper transaction of the public business.
REMEDIES FOR MACHINE GUN MALFUNCTIONS

PURPOSE

Difficulties encountered in synchronizing the fire of Browning machine guns with the airplane propeller may be overcome by compliance with technical orders which have been issued. In order to make this information available in one publication, this circular has been compiled from the technical orders, with the addition of explanatory matter wherever it was found advisable.

GENERAL

Synchronizing troubles may be caused by failure of either the gun or synchronizer to function properly. The fact that a gun fires satisfactorily automatically does not mean that it will give satisfactory results when synchronized. For satisfactory synchronization, gun parts must fit properly and function smoothly. Loose or worn parts, if contained either in the synchronizing mechanism or in the mechanism of the gun, must be replaced. In order to clearly analyze the troubles which may be encountered during the service use of this class of equipment, the subject matter will be subdivided as follows:

MACHINE GUN TROUBLES

HEAD SPACE

1. Some difficulty has been experienced with the Browning aircraft machine gun due to head-space trouble. This is found to be caused by using ammunition having loose bullets or by turning of the barrel. The head-space trouble due to the barrel turning is the result of using a screw driver to adjust the head space while the barrel is in the gun. This results in breaking down the notches in the end of the barrel and allowing it to turn more easily.

2. The standard method of adjusting head space, as specified in the Handbook on the Browning Aircraft Machine Gun, is correct and will give satisfactory results with new guns. In the case of old and worn guns, in which the standard method has not been found to be entirely satisfactory, the following method has been followed with good results:

Adjust the head space by the standard method and screw up on the barrel one notch at a time until the barrel will not go home, when the barrel, barrel extension, and bolt are assembled in the receiver. Unscrew one notch and try a dummy cartridge, or live cartridge if the gun is at the firing butts. If the barrel goes home without undue effort, the adjustment may be assumed to be correct. If unusual effort is required to close the bolt on the dummy or live round, continue to unscrew the barrel one notch at a time until a point is reached at which the bolt will close and lock the barrel in the forward position. Experience to date indicates that guns will synchronize properly if the head-space adjustment is as close as possible.

3. A number of instances have been encountered wherein an apparent head-space trouble was caused by faulty ammunition. Ammunition having loose bullets, if used, will cause powder to collect in the chamber and on the face of the bolt, which will seriously interfere with the proper adjustment of the head space. Any deposit of burnt powder observed in the chamber or on the face of the bolt should be removed in order to eliminate the possibility of malfunction due to causes mentioned above.

AMMUNITION

The ammunition used should be inspected as closely as possible for general condition and to see that there are no loose bullets. This inspection should include the twisting of each bullet by hand. Loose bullets may cause breakage of parts through excessive pressure or malfunction of the mechanism due to burnt-powder deposits.

LENGTH OF FIRE

1. Tests have been conducted recently to determine the length of bursts which can be safely fired by a .30 caliber aircraft machine gun located under airplane cowling, without danger of preignition caused by the heat of the barrel. It has been found by actual tests that when firing bursts of over 225 rounds the next cartridge in the chamber would fire prematurely. Bursts of 225 rounds, although possible, will cause excessive wear on the moving parts of the gun and decrease the life of the barrel. It is, therefore, recommended that bursts of not over 125 rounds of ammunition be used during all peace-time activities, as by such procedure maintenance problems will be reduced.

2. In firing synchronized guns where there is an appreciable time between bursts, it is recommended that the charging handle be pulled to the rear and locked until ready to fire the next burst. This eliminates the possibility of a cartridge expanding and sticking in the chamber and allows the air stream to clear the bore of gases and permits the entire mechanism to operate at a reduced temperature.

FIRING MECHANISMS

1. It has been found in operating the Browning aircraft machine gun, Model 1918 M1 as a free gun, that it is necessary to leave the trigger motor on the gun. If this is not done the extractor cam plunger occasionally enters the trigger motor slide in the side plate and causes malfunction. It has also been found that some of the cocking levers have been breaking, and upon investigation of some of these it was found that the tempering is too hard. It is not known at this time if all cocking levers in the service are too hard, and therefore any information on troubles of this character should be forwarded to this division in order that proper corrections may be made.

27918—257
2. It has been noted in some Browning .30 caliber Model 1918 M1 machine guns, that the sears and sear slides are loose, causing excessive dispersion of shots when the guns are synchronized. An improperly seated sear and sear slide are shown in Figure 1. Guns which are in this condition should not be used for synchronized firing until repaired.

3. The sear and sear slide should fit as shown in Figure 2. The end of the sear slide should be about flush with the outside face of the bolt when the gun is cocked and should require very little lateral movement before it comes in contact with the sear. The sear should move freely in its guide but should not have excessive freedom in lateral movement. Sears and sear slides should be interchanged until a satisfactory fit is obtained with the parts available.

4. Variations in the dimensions of some guns cause the trigger motor to be located too far to the rear and result in the trigger motor slide catching in front of the sear slide as shown in Figure 3. This can be remedied by filing the trigger motor as shown in Figure 4. (Figs. 1 to 4 shown on page 3.)

5. Proper adjustment of head space, as mentioned above, will tend to make loose-fitting bolts operate more satisfactorily, but it may be necessary in some cases to discard certain bolts. The attention of the Ordnance Department should be directed toward instances where the gun parts can not be used.

SYNCHRONIZING TROUBLES
SYNCHRONIZATION

1. The following method will be followed in synchronizing fixed guns on airplanes when the Nelson machine-gun synchronizer is used. All other points of installation, adjustment, and maintenance will be made as directed in the Handbook on the Nelson Machine-Gun Synchronizer, dated November, 1922.

a. Set the generator on the drive shaft with the cam shaft and coupling flange temporarily connected and the torque arm and vertical spacer connected.

b. Adjust the thrust rod until the cam shaft and drive shaft are properly aligned.

c. Connect the impulse cable to the generator rocker lever and trigger motor lever or rocker shaft arm as the installation requires.

d. Cock the empty gun and rotate the propeller, adjusting the length of the impulse cable until the firing pin is released just before the tappet reaches the peak of the cam. The impulse cable should be adjusted to travel from \( \frac{1}{2} \) to \( \frac{3}{2} \) inch toward the generator after the firing pin is released.

NOTE.—In making the above adjustment, the control levers mounted on the stick of the airplane should be operated in order to make sure that the control plunger when released will enter behind the lower part of the rocker lever. Installations have been encountered wherein a very fine adjustment is required to obtain proper function of the operating unit and at the same time have the proper overtravel.

e. Turn the propeller forward a small amount and cock the gun. Then turn the propeller forward until it reaches the exact position at which the firing pin is released. Hold the synchronizer cam shaft to prevent it from turning and disconnect it from the coupling flange. The propeller should be placed so that the line of sight through the center of the bore of the gun is from 2 to 3 inches behind the trailing edge of the blade. The cam shaft is provided with 18 and the coupling flange with 20 holes. This allows an adjustment to within 2 degrees. With the propeller and cam shaft in the above positions, the coupling flanges should be connected. If the holes are not aligned, turn the propeller ahead a small amount until the connection can be made.

f. After synchronization is completed, turn the propeller at least one complete revolution with the operating lever released BEFORE loading the gun. This will prevent an accidental shot being fired when the engine is started because it makes certain that the plunger is positioned to hold the rocker lever away from the tappet.

2. The act of synchronizing a machine gun requires a bore-sighting operation which may be greatly facilitated by provision of an empty cartridge case having a small hole drilled through the primer. An empty case prepared in this way may be placed in the chamber and the hole used as a peep sight. This arrangement eliminates personal error as much as possible.
DEFECTS IN BROWNING MACHINE GUN-FIRING MECHANISM

**Fig. 1**

**Fig. 2**

**Fig. 3**

**Fig. 4**
3. In synchronizing machine guns, it is recommended that the position of the zero shot in relation to the trailing edge of the propeller blade be controlled only by use of the vernier hole adjustment. Instances have been known where the final positioning of the zero shot has been made by use of the impulse cable adjustment. This practice has been found to be very dangerous. The impulse cable length should be adjusted properly and not changed to facilitate the positioning of the zero shot.

REMOVAL OF IMPULSE GENERATOR

Impulse generators having Nelson synchronizers should not remain on the engine when the thrust rods and guns have been removed from the airplane, in case the guns only are removed, the generators and thrust rods may remain when it is the intention to replace the guns within a short time. When it is not the intention to replace the guns within a reasonable length of time, the thrust rods and generators should be removed.

Rocker-shaft Bracket Screws

It has been found in some cases that the two screws, part No. SK-2567, used to secure the Nelson machine-gun synchronizer rocker-shaft bracket, part No. 046936, to the trunnion block of the Browning aircraft machine gun, work loose under strain of the synchronizer. It is, therefore, directed that these screws, after being tightened firmly, be staked to the rocker-shaft bracket by means of a center punch. Two punch marks shall be made for each screw, one at each end of the screw slot.

Impulse Generator Cams

Considerable trouble has been experienced in some .30-caliber Browning aircraft machine guns using Nelson synchronizers, due to the excessive play between the bolt and the side walls of the receiver. With this excessive play, the travel of the trigger motor plunger of the Nelson synchronizer is not sufficient to cause proper functioning of the gun. It is, therefore, directed that whenever trouble of this nature is experienced with this type of gun the synchronizer generator cam B-901 be ground as shown in the drawing on page 2. The cams so modified will wear fast, as the casehardening has been ground off, and should be replaced as soon as they show excessive wear. Air Service Engineering Division drawing M-3953 shows the proper procedure for grinding the machine-gun synchronizer generator cam.

Coupling Flanges and Bolts

Synchronizer generator coupling flanges and bolts wear excessively when the bolts are not properly tightened or the generator is not properly aligned with the cam shaft. Although these bolts are not easily accessible, they must be kept tight and should be inspected frequently to prevent trouble. In entering the bolts in the vernier holes, care should be exercised in properly entering the dowel between the lower and upper flanges and in entering the bolts in the proper holes. In no instance should it be necessary to drive or force the bolts into position, as poor alignment of these parts is almost a sure indication of later malfunction.

Excessive Wear of Cam or Follower

Excessive wear of the impulse generator cam or follower is due to lack of lubrication. The generator should be packed with grease and inspected frequently to prevent running dry.

Springs

Springs in the trigger motor rocker shaft and operating control should be inspected frequently for weakness or permanent set, which may occur if the springs are left under compression on the airplane for a considerable length of time.

Cable Connection

Soldered cable connections should be inspected frequently for slippage of the cable. Slippage at joints in the impulse cable will change the synchronization, and this should be checked immediately before each flight.

Rocker Shafts

Rocker shafts may bend if left under torsion and should be inspected frequently. Bending of the rocker shaft will change synchronization and may necessitate adjustment of the impulse cable to permit firing of the gun.

Operating Controls

If operating controls are installed with sharp bends the cable will bind. This unit should be frequently checked to insure easy operation. Adjustment of the control must be carefully made to insure that the gun will not be fired when the hand trigger is moved from the operating position to the loaded position.

Thrust Rods on MB-3A Airplanes

Thrust rods on MB-3A airplanes sometimes break at the welded end adjacent to the gun-mount frame, due to poor welding and excessive vibration. These parts should be inspected frequently. Tests made in the service indicate that the angularity of this rod with the impulse cable does not effect synchronization.