custom benchrest actions

BENCHREST TRIGGERS

by Stuart Otteson

THREE DECADES ago, when modern benchrest shooting was in its infancy, a wide variety of triggers were being used, ranging from tuned-up military rigs all the way to complex European double-set types. Few of these extremes are seen now. Today's benchrest shooter has pretty much settled on the so-called two-ounce trigger, a particularly useful compromise that came to the fore in benchrest shooting during the 1960s.

Specific evaluations of currently available two-ounce triggers, including those made by Kenyon, Hart, Remington, and Canjar, will follow in later articles. But first, as an introduction, let's explore some general aspects of match-trigger design and performance. In addition, figures two through nine give a brief thumbnail sketch of various trigger types that have been used in bolt-action rifles.

Because really heavy trigger pulls are so incompatible with accurate shooting, the search for light triggers goes back almost to the origins of firearms. The effort required to release a ten or fifteen-pound trigger, for example, obviously renders good marksmanship a practical impossibility. About the heaviest pulls actually preferred by match shooters today run around two to three pounds, but then generally only by those long accustomed to shooting under the old three-pound-trigger rules.

The objection to a heavy pull is twofold. First, it leads to gripping the rifle so tightly that a truly stable hold becomes very difficult. Second, it becomes much harder to fire the instant one desires, because the ability to accurately judge the pressure being applied decreases sharply as pull weights increase.

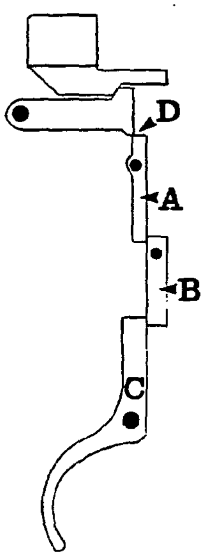
On the opposite end of the scale, it is erroneous to assume that the lighter a trigger pull can be made, the better. While pulls of a fraction of an ounce are readily obtainable, such triggers are very difficult to use properly. If we assume that most competitors, even those shooting "free recoil," want to control the firing process, it then follows that one must be able to place the finger firmly enough against the trigger shoe to accurately gauge the pressure being applied. For me, that takes at least a four or five-ounce pull, although obviously the sense of touch varies, and many shooters are successful with lesser weights.

In general, a pull somewhere between two and eight ounces seems about as low as most shooters can control effectively. For some, that point may even be as high as sixteen ounces. But whatever it is for any particular shooter, anything less introduces the possibility of random contact discharging the trigger.

Although we tend to focus on pull *weight*, triggers of course have other very important attributes. Engagement should be small enough so that the finger movement necessary to release the trigger (sometimes called creep) is imperceptible. Again, for me, that figure is about 0.010 inch. Any movement that can be felt tends to confuse the firing process and thus oppose a precise and fast release.

Overtravel, movement following release (sometimes called backlash or slap), must also be controlled, and here an even smaller figure is desirable. If the finger is allowed to momentarily accelerate after the trigger breaks, then when it does reach its stop, the aim of the rifle can be thrown off.

A trigger must also be uniform or repeatable. Regardless of how sensational its performance may be



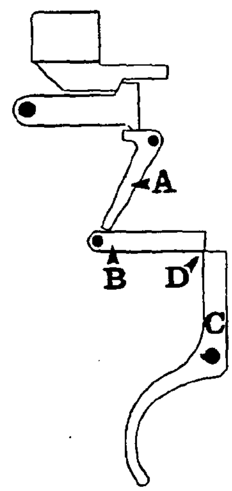


Figure 1 In both of these multiple-lever arrangements, the extra levers *A* and *B* reduce the weight of pull required at trigger piece C. In the arrangement at the left, however, these levers are below disengagement point *D*, so they act simply as extensions of the trigger piece. All the extra movement that they introduce must be supplied by finger movement, which would obviously produce a hopelessly long pull. In the arrangement at the right, these extra levers are above the disengagement point, in the automatic or override circuit of the trigger. Motion is thus provided by the firing-pin spring after the disengagement surfaces "break."

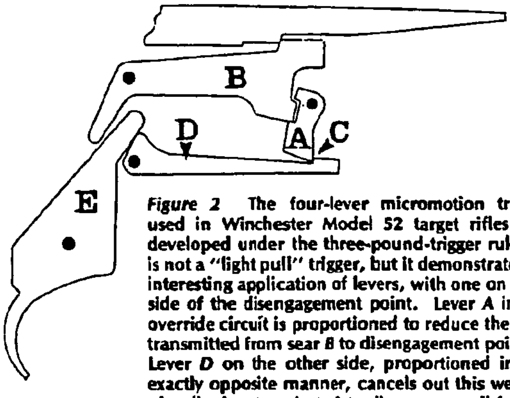


Figure 2 The four-lever micromotion trigger used in Winchester Model 52 target rifles was developed under the three-pound-trigger rules; it is not a "light pull" trigger, but it demonstrates an interesting application of levers, with one on each side of the disengagement point. Lever *A* in the override circuit is proportioned to reduce the load transmitted from sear *B* to disengagement point *C*. Lever *D* on the other side, proportioned in the exactly opposite manner, cancels out this weight-of-pull advantage but virtually removes all feeling of movement at trigger piece *E*.

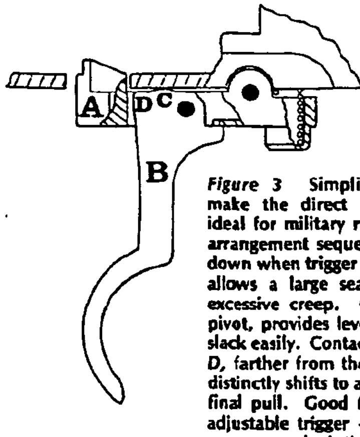


Figure 3 Simplicity and durability make the direct double-draw trigger ideal for military rifles. A double-cam arrangement sequentially draws sear *A* down when trigger piece *B* is pulled and allows a large sear stand-up without excessive creep. Cam *C*, close to its pivot, provides leverage to take up the slack easily. Contact of the second cam, *D*, farther from the pivot abruptly and distinctly shifts to a sharper and cleaner final pull. Good features of this non-adjustable trigger — besides reliability — are zero lock time and the ability to retract fully.

otherwise, shot-to-shot variations can render all for naught. They not only make it difficult to get the shot off at exactly the right moment, they affect hold also. This is probably the single biggest challenge in match-trigger design.

Retraction concerns the trigger's ability to return to full original engagement if it is pulled partially through without firing. The argument is that without retraction, the rifle can be left in a potentially unsafe state. Benchrest shooters do not normally "play" the trigger, at least in the same sense that position shooters do. This is perhaps fortunate, because as will be seen in later articles, benchrest triggers generally exhibit little if any ability to retract.

Sensitivity is a more practical concern. If a trigger starts releasing on either the opening or the closing of the bolt, even only very occasionally, you've got a big problem on your hands. Triggers that sometimes just seem to "cook off" on their own are of course an even greater liability.

The trigger's lock time, while obviously not as critical to benchrest as to position shooting, is nonetheless important also. It adds directly to the lock time of the firing pin and the ignition process, making the overall delay between the conscious action of the shooter and the exit of the bullet from the muzzle that much greater.

Finally, vibration generated by the trigger can affect accuracy. Rimfire rifles are particularly sensitive, and triggers like those in the Winchester Model 52 have long been advertised as being vibration-free, an attempt to clearly set them apart in customers' minds from set triggers, where a sizable impact is part and parcel of the release process.

Getting back to trigger weight, what sets the limits for light pull? It is sometimes assumed that spring tension alone determines weight of pull. But friction is also a factor, one that unfortunately is not nearly so easily managed as spring tension.

For the kind of trigger pulls normally associated with hunting rifles (say three to six pounds), spring tension is significant, and weight of pull responds readily to spring adjustment. Yet in these same triggers, the underlying friction is usually high enough so that trying to go down to really light weights is an exercise in futility. You could in fact literally take out and discard the trigger spring in most hunting triggers and still not even approach match-level pulls.

This friction, which must be drastically reduced to get a *truly light, safe,* trigger pull, is caused primarily by the fact that the two metal surfaces that must slide out of engagement with each other normally also carry the mainspring load. They are thus pressed together very tightly, and resistance to sliding movement is determined just as much by this pressure as it is by the "slickness" or *coefficient of friction* of the two surfaces.

We can sit back and theorize four possible ways to lighten the pull of a purely mechanical trigger:

lighten the trigger spring

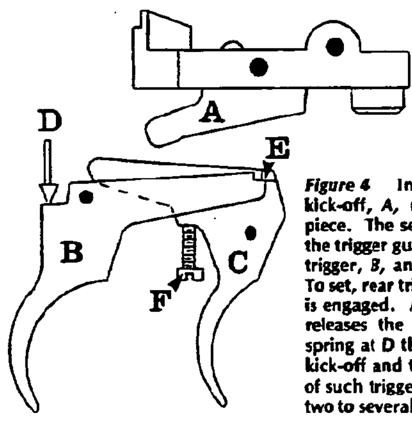


Figure 4 In this double set trigger, the kick-off, *A*, replaces the usual trigger piece. The set mechanism, mounted in the trigger guard, includes a rear setting trigger, *B*, and a front firing trigger, *C*. To set, rear trigger is pulled until ledge *E* is engaged. A pull on the firing trigger releases the set rear trigger, which a spring at *D* throws upward to strike the kick-off and thus fire the rifle. The pull of such triggers varies from an ounce or two to several pounds.

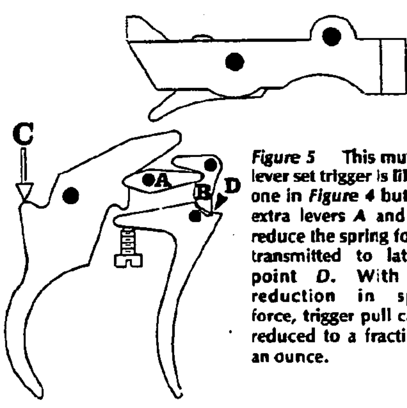


Figure 5 This multiple-lever set trigger is like the one in *Figure 4* but with extra levers *A* and *B* to reduce the spring force *C* transmitted to latching point *D*. With this reduction in spring force, trigger pull can be reduced to a fraction of an ounce.

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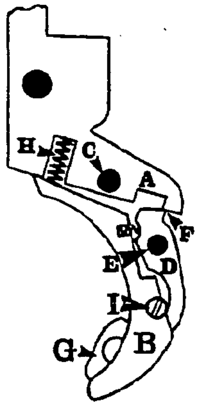

Figure 6 This single set trigger developed by Canjar in the Forties uses one trigger to both set and fire the mechanism. The set shoe *B*, containing release tab *D* and the required springs, attaches to the lower stub of trigger piece *A* rather than being mounted in the trigger guard. Set shoe *B* is recessed for tab *D*, which pivots at *E*. Pushing the shoe forward latches the release tab at *F* and lets it protrude forward at *G*. A touch on the tab at *G* releases it, and coil spring *H* snaps the shoe back to fire the main trigger. Pull adjusts from two ounces down to less than an ounce by screw *I*.

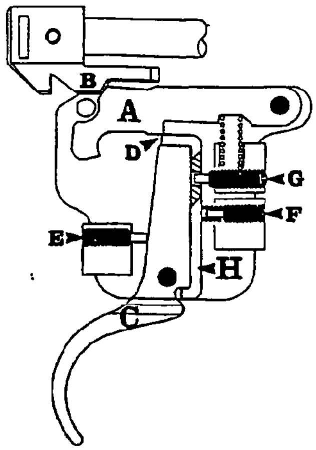

Figure 7 In this commercial override trigger, sear *A* blocks cocking piece *B* and is supported by trigger piece C. Engagement of the cocking piece can be large, with sear engagement *D* small. This trigger is fully adjustable for engagement *E*, weight *F*, and overtravel *G*. Typical weight is two to four pounds, engagement 0.012 inch, overtravel 0.005 inch. Connector strap *H* between sear *A* and trigger piece *C* gives this Remington Model 700 trigger a special "resilient" release, as explained in *Rifle* 64, page 18.

- increase trigger-piece leverage
- smooth the disengagement surfaces
- remove the load from the disengagement surfaces

As already noted, for the kind of pull weights we are interested in here, spring forces are already pretty well out of the picture. Thus while a light trigger spring is necessary to avoid *adding* resistance, it can't in itself take us down to anything like a two to eight-ounce level.

Fooling with the leverage of the trigger piece is not a highly useful approach either, as any gain extracts an exactly proportional price in trigger movement. In figure seven, the trigger piece pivots roughly at its midpoint. Thus if disengagement with the sear takes three pounds and 0.012 inch at D, essentially the same must be applied by the finger against the trigger shoe. If the pivot were relocated closer to the sear, let-off weight would be reduced, but finger movement would increase by exactly the same ratio. Trigger-piece leverage could also be improved with separate pivoted levers as shown in the first sketch in figure one, but this tends to be impractical for the same reasons.

Smooth disengagement surfaces of course reduce the coefficient of friction. Yet most properly made triggers are pretty smooth to begin with, and so regardless of how carefully they are polished, practical gains here are relatively limited.

Thus by a process of elimination, we are almost forced into devising schemes to decrease the contact load carried by the trigger piece, and it is here that the true diversity and ingenuity of the various types of triggers comes into evidence. Mechanically, there are two basic approaches. The *set trigger* separates the trigger from the firing-pin system, then adds a miniature impact device between them. It is based on the theory that it takes a lot less of a blow to dislodge a sear than to ignite a primer. Thus while the firing pin may have a twenty-five-pound mainspring, something closer to a two or three-pound spring may suffice to kick off the sear. Since the sliding friction between two surfaces is directly proportional to the load they are supporting, this can automatically bring let-off effort in the trigger down from the *pound* to the *ounce* neighborhood.

We can get essentially the same result by adding one or more pivoted levers into the trigger's override circuit, as shown by the second sketch in figure one. Each lever is proportioned to cut down on the amount of mainspring load passed along to the actual disengagement point. The addition of a single lever results in the most common variety of multiple-lever

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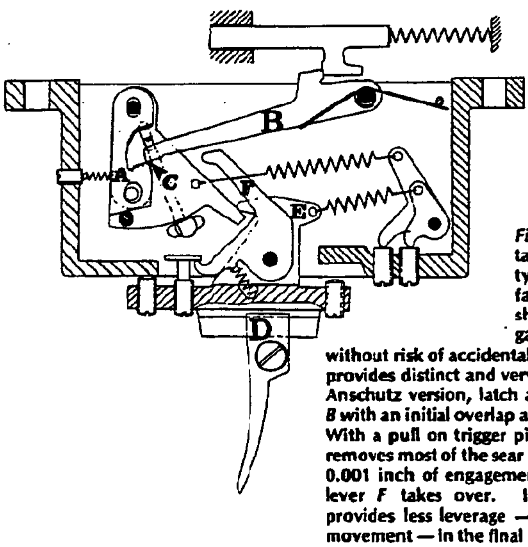

Figure 8 This two-stage target trigger provides a type of trigger control favored by some position shooters. Initial sear engagement can be "played" without risk of accidental firing. The second stage provides distinct and very sensitive release. In this Anschutz version, latch assembly *A* supports sear *B* with an initial overlap at C of roughly 0.010 inch. With a pull on trigger piece *D*, first-stage lever *E* removes most of the sear engagement; when about 0.001 inch of engagement remains, second-stage lever *F* takes over. Its longer moment arm provides less leverage — but also less perceived movement — in the final pull.

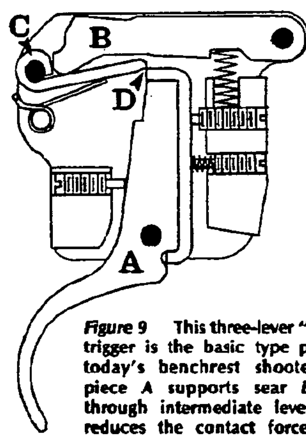

Figure 9 This three-lever "two-ounce" trigger is the basic type preferred by today's benchrest shooters. Trigger piece *A* supports sear *B* indirectly through intermediate lever *C*, which reduces the contact force at release point D enough to make pull as light as two ounces possible. This Remington trigger is fully adjustable also.