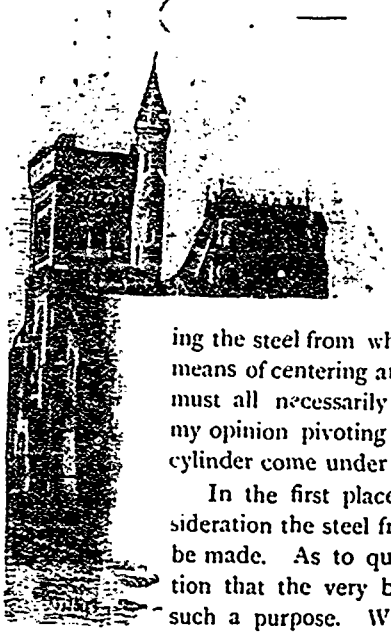
(452) We will first suppose that we want to measure the angular motion of the balance. The balance is first removed, the movement placed in a suitable ring, and adjusted till the arbor point will come in the lower pivot hole, and securely fastened there. The balance is then replaced, and its cock screwed on, or, if that is to be omitted, (447), the upper pivot is supported by the female centre end of the arbor. The lever, *d*, is then caused to move to one end of the slot, *C*, by turning the wheel, *h*, and moving the stud, *i*, and the upper end of the spring, *f*, in the right direction. An arm, *l*, with a suitably shaped claw, *m*, is then adjusted in contact with the balance arm, or rim, or a screw. The lever fork of the watch is then pressed against one of the banks, with the ruby pin resting against the inner side of the notch,—this position of the parts representing one extremity of the action of the fork on the ruby pin. Finally, the pointer, *e*, is moved to any degree on the scale, *D*, that you wish to start from, but preferably, in most cases, to the *O* at the same end as the lever, *d*, stands.

MAKING AND REPLACING THE BALANCE STAFF.

PRIZE ESSAY BY C. E. BILLINGS, LONDON, ONT.



THERE is a great deal more in the above named subject than a first glance implies, for the subject covers a great deal of ground. The quality and best method of hardening and tempering the steel from which it is made, the best means of centering and the use of the graver must all necessarily be considered, and in my opinion pivoting a staff and replacing a cylinder come under the same head.

In the first place, let us take into consideration the steel from which the staff is to be made. As to quality, it is beyond question that the very best only is suitable for such a purpose. When I turned my own blanks I used Stub's steel wire of the required diameter, and as all watchmakers know, nothing better in regard to quality can be procured. I have since found a very good blank staff in the material stores, which is sold at from 40 to 50 cents per dozen, and I buy them in preference to turning my own blanks. They are supposed to be tempered too, but I never trust them in this respect, but always harden and temper them myself so that I always know just what kind of metal I am working.

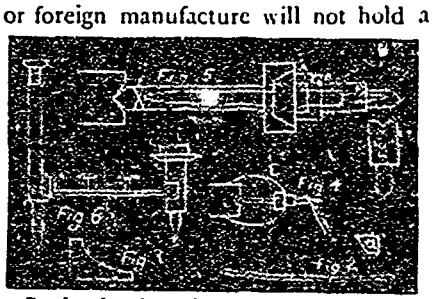
In regard to hardening steel there is at present considerable controversy, and any number of methods. I have at different times and for different purposes tried castor oil, linseed oil, sperm oil, petroleum, fresh water, salt water and mercury. The three first named oils in my opinion gave the same general result. Fresh water gives the same degree of hardness, bu does not leave the steel as tough as the oil. Petroleum renders the metal a trifle harder than the other oils, and at no apparent cost in regard to brittleness, while either salt water or mercury renders the metal so very brittle as to be only suitable for large or medium sized drills, and is of no particular advantage in hardening such a piece as a balance staff.

In hardening I take about a dozen blank staffs, lay them in a hollow on a piece of charcoal and cover them with a thin piece of soap, and by means of a good-sized alcohol flame and a blow-pipe, heat them to a cherry red and then plunge them quickly into linseed oil.

In performing this operation see that as the flame is directed, the soap rapidly melts and covers the pieces with a thin black coating which will serve to exclude the air while heating. If it is properly done, the sudden cooling causes this shell to chip off and leave the blank staff perfectly white, but should the result not be so satisfactory, a little rolling between the fingers will remove it, or should you desire a better polish and are the possessor of an American lathe, they can be quickly and nicely polished with a fine emery stick.

To temper them, the best manner is to pack them in a metal receptacle, similar to a boiling-out cup, filled with fine brass filings, in such a manner that the color may be observed as the changes occur. Hold them over an alcohol flame and subject them to about 530° Farenheit, which would bring the color to a dark purple. This, I think, is sufficiently hard for a balance staff, and they should by no means be made softer. It will, upon a fair trial, be found that a staff of such a degree of hardness can be very readily turned with a good graver in good condition, is capable of taking a very fine polish and will produce a good wearing pivot and will stand more hard usage, while in the watch, in the way of sudden shocks, and falls, than a staff either of a greater or less degree of hardness.

Having prepared our blanks, the lathe is the next consideration. Some workmen still insist that there is nothing to equal the bow lathe for fine work, and I am willing to admit that I have seen some of the finest kind of work produced by that means. Others, however, claim that continuous motion will produce as good work and do it quicker. I am of the latter opinion. I also claim that a split chuck in a lathe of American or foreign manufacture will not hold a piece *abso-*



lutely true. Such chucks will no doubt do well enough for ordinary work, but when a fine staff or pivot is to be turned, I agree with the manufacturer of the leading American lathe, that nothing equals a *well centered* cement chuck. I have tried almost every make of lathe, and have come to the conclusion that for the finest kind of work the Swiss or cement lathe is most suitable on account of its lightness and the facility with which the wearing parts may be adjusted: or a cement brass may also be used with an American lathe, and it must be borne