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# Relying on "On Practice" and "On Contradiction" To Make a Chinese-Type Frequency Clock

by FANG FU-KEN

USING the great Mao Tse-tung's thought as our weapon, we succeeded in making China's first frequency clock after working hard for a year and more. Compared with foreign-made clocks of this kind, it is much simpler and more rational in construction, much more convenient to manufacture and use, and much cheaper to make. Moreover, its accuracy is up to the most advanced level. This is a frequency clock of a specifically Chinese type.

Before we started on the job we did not know what a frequency clock was; we'd never even heard the name. I was an apprentice in a pen-nib factory. Though I had studied two years in secondary technical school, I did not learn clock-making. There were several other comrades some of whom had studied how to make watches and clocks, but none of them had seen a frequency clock either. What is a frequency clock? It is used not only for ordinary timing, but also as an indispensable precision meter for a power station to measure the frequency of its electric current. A much greater degree of accuracy is demanded of it than from ordinary watches and clocks. Ordinarily a best quality watch or clock may gain or lose 10 seconds or more in every 24 hours, but the daily deviation permitted a frequency clock cannot exceed one second. It was all by relying on Chairman Mao's writings, *On Practice* and *On Contradiction*, that we were able to make a frequency clock. These two works armed our minds, helped us topple blind faith in bourgeois "authorities" and "specialists" and "foreign books," and gave us the sharp weapon for knowing and transforming the objective world.

We accepted this task in the spring of 1964.

We heard that the power bureau had a frequency clock made in the United States in the 1920s. We all said: "Better first take a look at that before we make our plans!" But it gave us little except a surprise. It was kept in an instrument room at a constant temperature and attended by a veteran worker all the year round. It was never opened up unless for checking, because it could not stand the slightest vibration or any dust.

I approached the clock and looked at it through its glass door. Its gears were badly worn down and much

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of the chrome had fallen off. It was older than I was. We young technicians studying watches and clocks felt it would really be a shame if we continued to use such a crude piece and could not replace it with a Chinese-made frequency clock. A big Chinese-built hydroelectric power station, we heard, was totally equipped by us except for one thing—an imported frequency clock. No matter what, we felt, we must fill in this gap! Today, we are the great Chinese workers and proletarian fighters armed with Mao Tse-tung's thought, why couldn't we catch up with and surpass the Western bourgeoisie in the skills of clock-making? We all shared the same aspiration; no matter what we must make a better frequency clock in our own way!

Our Party branch pointed out to us that the trial manufacture of a frequency clock was an important political task and that we should turn the process of trial manufacture into a process of creatively studying and applying Chairman Mao's works. The education given us by the Party further enhanced our confidence in trial manufacturing the frequency clock.

## Having Firm Confidence in Chairman Mao's Teachings, Taking Our Own Road

But, what kind of frequency clock did we really want to make? Opinions differed and there was no lack of conflicting ideas among us.

Some engineers, with blind faith in the science and technology of certain other countries, could never get away from the idea that we could only rely on the "foreign stick" to walk on. They said: "Since the time allotted to the job is so short and since we are not so sure of things, it is better to refer to a foreign model." But what they meant by "referring" was actually "to copy" a foreign model.

Studying the matter, we went on one occasion to Anhwei Province to inspect a frequency clock imported several years ago. It was a complex affair with a great many gears, parts and an intricate web of wires. Yet it failed to work smoothly, breaking down from time to time, like a person suffering from some chronic disease. When we arrived, we found it in a state of relapse and the comrades there were having difficulties putting it back into working order. This showed how the revisionists tried to bully us, but the strange thing was that some people still considered that clock to be such a wonderful thing and thought that we ought to pattern everything on it—its construction, parts, and even its wooden casing and screws.

Such an attitude made some of us indignant. How ridiculous that they should think we Chinese didn't even know how to make the screws but had to copy them from others! Chairman Mao has taught us: In learning from others, it is necessary "to use our heads and learn those things which suit conditions in our country, that is, to absorb whatever experience is useful to us. This is the attitude we should adopt." The attitude of blind worship of foreign stereotypes adopted by certain "specialists" and "authorities" simply dampened our own revolutionary spirits and inflated the arrogance of the bourgeoisie! We must follow Chairman Mao's teachings in real earnest, learn through practice, and be daring in making new things and learning from others with a revolutionary and critical attitude. Some comrades, however, thought that such an approach showed a lack of a serious attitude, exacting demands and a highly scientific method. I had my reservations. I just could not agree that we lacked a serious attitude, exacting demands and a highly scientific method in following Chairman Mao's advice to test everything out in practice and to base our conclusions on practice, and that those who copied everything from other countries were the opposite.

Reasoning this way, I put forward my own plan for the design. Then the so-called "authorities" asked me: "Is it based on any theory?" I said no, but added that theory would come out of practice. Their non-recognition led to the vetoing of my plan.

They spent several months making a frequency clock which was an exact copy of an imported model. Final tests showed that it lost or gained more than ten seconds a day, falling far short of the advanced world level of a permitted deviation of one second. Still those "authorities" refused to draw a lesson from this failure. Instead they attributed their failure to imperfections in "copying." So they started all over again, checking every part to make it exactly the same as the model. But what was the result? They found that the second copy still gained or lost five or six seconds in 24 hours.

All this served as a teacher by negative example. I became all the more convinced that blind faith in bourgeois "specialists" and "authorities" could only lead to a dead end whereas following Chairman Mao's words would lead me on to a broad open road. I became firmer in my determination: To do as Chairman Mao has taught us, be daring in practice, discard all stereotypes, be bold in challenging the bourgeois "authorities," and forge ahead unswervingly along our own road in developing technology.

### Practice Is the Best School

But how to open up a road of China's own?

I turned again to Chairman Mao's *On Practice*. Chairman Mao says: "How can you catch tiger cubs without entering the tiger's lair?" To know a thing, the fundamental way is through practice. As regards myself, I was no good at theory and even worse off as

to experience. There was only one way open to me: I must enter the "tiger's lair." So I decided to take an honest attitude and go ahead in practice, learning in the course of it. I would try out in practice all the various methods of other people and compare them, discovering their respective merits and shortcomings. In actually doing the work, I would get a thorough understanding of the relationship between the various parts of the frequency clock and the principles of how they work.

In this trial period, we made many experiments to solve the problem of the energy replenishing device. This is a most important part of the frequency clock. If we compare the pendulum to a soldier on a long march, this device can be compared to an "army canteen" which follows the soldiers on the march. The pendulum works unceasingly and accurately only when energy is supplied well and at the right time. The many types of foreign-made frequency clocks furnish many examples of how this "canteen" works. What is the best type and the one that suits our conditions?

We heard at that time that there was a most advanced timing method. But use of this method requires that the frequency clock be completely isolated from outside disturbances. To solve this contradiction, the clock has to be kept in a specially constructed underground room. I thought then: the spirit of our general line for socialist construction is to do things in a way that brings greater, faster, better and more economical results, and we should uphold this spirit. Can we supply our hydro-power stations with such delicate clocks? No, definitely not! This method is out of the question.

So we tried out the other methods one by one. After three months or more and dozens of experiments, although we still did not find a method entirely suited to our purpose, we had not wasted our time either. For by comparing the various methods that we tried out, we were able to get an over-all picture of each one's good and bad points. This enabled us to concentrate the good points in the new energy replenishing device that we designed on the basis of our needs. It worked very well. The clock did not have to be kept in an underground room, and the device could supply the energy at any time according to the needs of the pendulum.

To grasp the working principles of each part of the clock, I made minute examination of various phenomena. One night, I was studying the amplitude of the pendulum's swing when I discovered from the light refracted from the swinging pendulum that, after making its oscillations a few dozen times, the pendulum suddenly made a slight, almost imperceptible backwards and forwards motion. Was this accidental? But it was already deep in the night, and absolutely still all around, so no outside factor could have influenced it. If it was a regular thing, we had never observed it before. I decided to get to the bottom of this suspicious phenomenon.

This backwards and forwards motion was at most 0.3 second each time, so it was very tiring to watch and my eyes were soon aching. But in order to get first-hand material, I kept to my purpose steadily day in and day out. Those happened to be the hottest days in the year. The room where I worked was a small chamber built of concrete, only three by three metres square, originally used for storing blocks of ice. It had no windows, and one could not use an electric fan as even a breath of wind would affect the accuracy of the pendulum's swing. It was hot and stifling, and working there, one soon got drenched with sweat. But I persevered for one month, then two, and then three . . . and finally discovered the reasons. Once these were found, the contradiction was quickly solved.

Chairman Mao says: "Our chief method is to learn warfare through warfare . . . it is often not a matter of first learning and then doing, but of doing and then learning, for doing is itself learning." Through a period of practice, I finally succeeded in gaining an all-round and deeper knowledge of the laws of the frequency clock. I became more convinced than ever that practice is the best school. We can enhance our ability to know the objective world only through practice; and only through practice can we learn and gain the ability to transform the objective world.

### Daring to Challenge All the "Authorities"

Chairman Mao teaches us: "The movement of change in the world of objective reality is never-ending and so is man's cognition of truth through practice." The experience of others is not fixed and immutable; we are not only able to but we are duty bound to enrich and improve on their experience. The experience of others contains much that is valuable as well as dross. Only by breaking with the old concepts can we understand and create new things; only by breaking with conventions, daring to challenge all the "authorities," can we develop new techniques and strike out along our own path.

During the trial manufacture, we concentrated our efforts on solving the problem of the relationship between the pendulum and the gears. Ever since pendulum clocks were invented several hundred years ago, the pendulum has always been connected to the gears, but very few people suspected that this could be a source of trouble. After scores of analyses of frequency clocks and experiments I found that the problem lay precisely in the formulation that the pendulum activates the gears. If anything goes wrong within the complicated mechanism, it will increase the burden on the pendulum through the gears. This pendulum activating the gears is very much like a person carrying a heavy load, and trouble is bound to arise.

Early one morning I saw several long-distance runners, dressed only in singlets and shorts, racing effortlessly along the road. I said to myself: Why don't we think of a way to unburden the pendulum just as those runners have shed their coats and other clothes? Pur-

suings this line of thought, I discovered a very simple and very easy-to-overlook truth: the pendulum keeps the time, each oscillation of the pendulum, the tick and tock, marks two seconds. The gears follow the pendulum, their function being to record each swing. The pendulum and the gears are closely linked, but are two different things. I had a bold idea: separate the two, the pendulum from the gears, and let the signals transmitted from the pendulum activate the gears and record the oscillations by means of electricity.

To get their views I told the others about this idea. Some told me: "This can be tried out, but if this path leads anywhere, others would have been sure to have gone down it long ago." If others have not explored this path, I said to myself, that does not prove that it is a blind alley. If others had not gone down it, that made it all the more necessary for me to explore it. Everything must be tested in practice. So following this line of thought, I started my experiments. Things looked promising. After 24 hours, a deviation of only 0.5 second was registered. But at the same time a thorny new problem appeared: the clock sometimes stopped. We all put our heads together to solve it as we used to do when difficulties arose. Many young workers and technicians gave us their enthusiastic support and came up with a number of ideas. Those who had "experience" with clocks, however, had their doubts and said: "Never heard of a pendulum clock with gears actuated by electricity. Electricity is not a reliable thing. . . ."

We carefully analysed the various views expressed. We had narrowed the deviation from 5-6 seconds down to half a second. This showed that we were on the right track. Why it sometimes faltered was because we had not yet fully grasped the laws governing the application of electricity to activate the gears. Chairman Mao tells us: "In the fields of the struggle for production and scientific experiment, mankind makes constant progress and nature undergoes constant change; they never remain at the same level." At the present time, our control over electricity is being strengthened and the material conditions for using electricity are also developing. If we pressed on courageously with our experiments, the problem was sure to be solved.

So we made further observations, analyses and experiments until we finally found the answer. The clock stopped not because we used electricity, but because of flaws in some parts of the mechanism which affected the flow of current. We introduced several improvements and the current flowed freely, the movement of the frequency clock became more regular, loss or gain in time was confined to under one second in 24 hours.

In the trial manufacture of this clock, we also discovered that some formulae and laws were not without faults and inaccuracies. In a book about the mechanism of clocks, there was a formula worked out by a foreign scientist for calculating the size, position and weight of the pendulum. This formula had been employed in

making clocks for the past ten years or so. I myself used it in making the pendulum for our clock, but although it worked out all right in calculations it did not work out in practice. Who was at fault, the formula or I? At first I thought that we must be but after checking and rechecking our calculations I found that they were not in error.

Then we made several experiments with different materials and found that it was the formula which was at fault. It failed to take into consideration the important factor of what sort of material is used. Actually, the composition of the material used makes quite a big difference to the result. Pendulums of the same size, but of materials of different compositions were used in trials and we got a wide range of variations in their movements. Finally, I threw away the formula which "was theoretically so correct but gave such different results in practice," and did experiments according to the concrete situation. Thus we worked out the correct size, position and weight of the pendulum for our clock.

In the course of this brief practice, it was deeply impressed upon me that only by steadfastly maintaining a revolutionary and critical spirit can old concepts be demolished and new ones created, and inventions and progress be made. Those who believe that laws and principles in foreign books cannot be challenged are looking at things from the metaphysical point of view and not according to the law of the development of things. Mankind develops, nature develops, so man's cognition of the objective world must also develop. Traditional concepts of techniques, formulae and laws in books were all arrived at by others under certain conditions, but only by arming ourselves with Mao Tse-tung's thought and reappraising conclusions and formulae can we bring about new developments and creations in technology.

### Chinese-Type Frequency Clock — Product of Mao Tse-tung's Thought

With the principle of construction changed as a result of separation of the pendulum from the gears, and with several parts of the clock eliminated, the make-up of our frequency clock is much simpler than that of foreign ones. Some people expressed the doubt: "Since the frequency clock is a high precision mechanism, can quality be ensured now that you have simplified it like this?" This is again a conventional notion that only complicated things are precise. In fact, some of those complicated frequency clocks are not highly efficient. Take that imported frequency clock which the revisionists purposely used to humbug us with, for instance. It is very complicated in construction. As a result, negative factors emerge. It has more gears and parts, all of them linked with each other and this increases the burden on the pendulum, and adds to the trouble in use and maintenance. This is just as a Chinese proverb says: "It adds nothing to the success, but brings something to the failure."

The law of development of things is from simple to complex and from complex to simple on a new level. The first time-measuring device in the world is the sundial, and then the clepsydra develops. Later on when gears and springs are invented, and are linked up with the pendulum, the structure of a clock becomes complicated. Yet today, isn't there the electronic clock which has done away with the spring and the pendulum?

China is a great socialist country. We have the guidance of the great Mao Tse-tung's thought. All Chinese products should be produced from the standpoint of convenience in making and using. They must be at once precise and simple in the highest degree. Nowadays we should be able to know things and to create new things in accordance with the inherent law of development of things. I have studied and compared all types of foreign frequency clocks made since 1922 to some time around 1958. Their common characteristic is complexity in construction. This has something to do with the then scientific and technological level, with the social system. Not only is the structure of those frequency clocks made in capitalist or revisionist countries complex, but there are also some stereotyped complicated parts which scare people but are actually unnecessary. These are the products of their rotten ideology. In our frequency clock, there are no parts like this. In trial producing our frequency clock, we felt deeply that the creation of advanced products needs **first of all advanced ideas, the revolutionization of ideology; and the revolutionization of ideology depends on putting Mao Tse-tung's thought in command.**

In tune with China's reality, to produce a simpler and more rational frequency clock, one that can be made, used and maintained in a more convenient way, my worker colleagues and I with the support of the Party organization have made further experiments. In over 40 "operations," we have eliminated nearly half of the main parts of our frequency clock, and in machining the technical requirements over half of its parts have been lowered. Thus, the construction of our Chinese frequency clock is even simpler than that of an ordinary clock. Its accuracy has been greatly raised and stands at the most advanced level. It can be made from Chinese materials now available and made in ordinary clock plants.

Under the Party's leadership, and by the joint efforts of all the comrades concerned, and with the enthusiastic collaboration of brother departments, the first Chinese-style frequency clock finally came into being in September 1965.

The success of the trial production of the frequency clock is a victory for Mao Tse-tung's thought, is a product of *On Practice* and *On Contradiction*. We have produced our Chinese-style frequency clock, but there are even more Chinese-style things waiting to be produced. We must more consciously study Chairman Mao's works, further reform our subjective world and understand as well as transform the objective world better with Mao Tse-tung's thought.