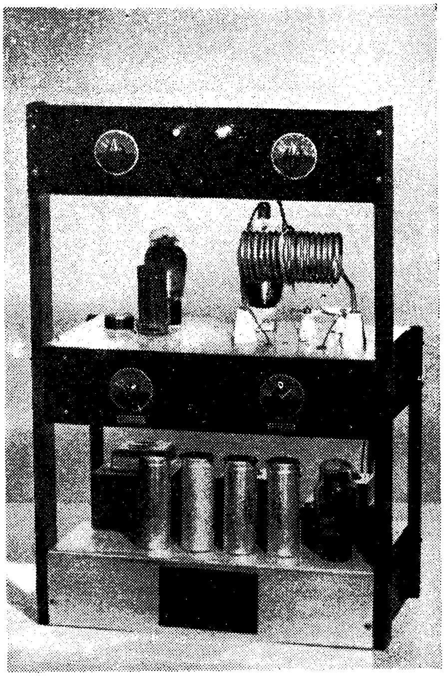
Your first TRANSMITTER

50 watts on 3 bands

Simplicity of construction and adjustment are the main features of this fine little transmitter. Its efficiency is particularly high, and full ratings are available for the 809 on any of the three bands. May be modulated for phone.



The transmitter from the front. Wooden chassis ends make "rack" construction particularly easy.

THE amateur transmitter, when faced with the problem of going on the air, must consider, first of all, how he is going to get his allowable 50 watts of input, assuming he desires to use it all. He can go about it by building a transmitter with many stages, which, when finished, will give him 50 watts on three or four bands, look imposing, and cost a fair amount of money. No one would quarrel with the man whose ideas ran on those lines —in fact, he will probably end up with a very fine transmitter and learn a good deal in the process. No doubt he will also have to know a good bit about the game to make a real success of the job, apart from anything else.

But there is another way of attacking the problem, which is essentially applicable to the new amateur. When building a first transmitter, which generally means an entirely new set of parts from the ground up, cost must play a big part. In fact, our advice to anyone using transmitting for a hobby is: Go easy on the pocket. Don't rush in and buy a lot of gear all at once!

Therefore, the solution which will provide the biggest appeal is the one which gives the most for the least money. A simple transmitter, which works well covers three bands from one crystal, and gives efficiency on all of them—this is the ideal equipment with which to start out.

It is exactly for this purpose that we have built and described the transmitter illustrated on these pages. Although meant primarily for the beginner, there is no reason at all why such a transmitter should not give excellent service to any amateur who looks for results at low cost.

PERFORMANCE

Although only two valves are used in the circuit, this transmitter is capable of giving with high efficiency that 50 watts on three bands of which we were speaking. For instance, with a 40-metre crystal, 40, 20, and 10 metres may be covered merely by changing coils and retuning two controls. With an 80-metre crystal, 80, 40, and 20 metres can be covered. As a rule three bands is all any amateur will cover at a time, and, in any case, he would scarcely expect his transmitter to include them all unless he is a quick-change expert. Our experience is that the average man rarely uses even three bands regularly over a period. If he covers 80, he will generally run to 40, but rarely 20 or 10. If he is a 20-metre crank, he rarely goes up to 40, but often to 10. In other words, three bands will cover the needs of practically everybody. If two crystals are available, one for 80 and one for 40, four bands can, of course, be covered.

Remember, this is with only two valves.

THE OSCILLATOR

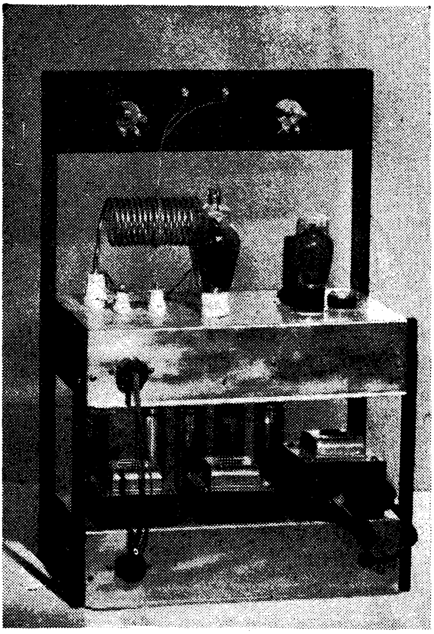
The first is a 6L6G type. It is used as a crystal oscillator and doubler. The final amplifier is an 809 type, also used as an amplifier or a doubler.

An oscillator circuit is used for the 6L6G, which is a variant of the Tri-tet circuit, and needs only one tuning control—that in the plate circuit. The cathode tuning is fixed and need not be touched unless a crystal for another band is desired. For instance, if only 40-metre crystals are used, the coil will suit any of them. If an 80-metre crystal is used, it will be wound for 80 metres, and will suit any such crystal. If a change is desired between 40 and 80 metre crystals, this coil should be made a plug-in type and mounted on the chassis in the normal manner. In our case we have used a coil soldered straight into position under the chassis, where it is out of the way.

This circuit we have found highly efficient—provided the right cathode coil is used the crystal current is not high and the output on the harmonic is practically as high as that on the fundamental.

It can also be used as a straight crystal oscillator without any feedback, as will generally take place with a straight Tri-tet. Useful output can be obtained on 10 metres from a 40-metre crystal, but we find it a much better scheme to double in the next stage, par-

★ THREE BANDS — ONE CRYSTAL
★ FIFTY WATTS ON EACH BAND
★ TWO TUNING CONTROLS
★ ONLY TWO VALVES USED



This rear view of the transmitter gives further constructional details. Note the power cable joining the two chassis. A tuned aerial coupler may be used if required.

ticularly as the 809 is such an excellent doubler.

NO REGENERATION?

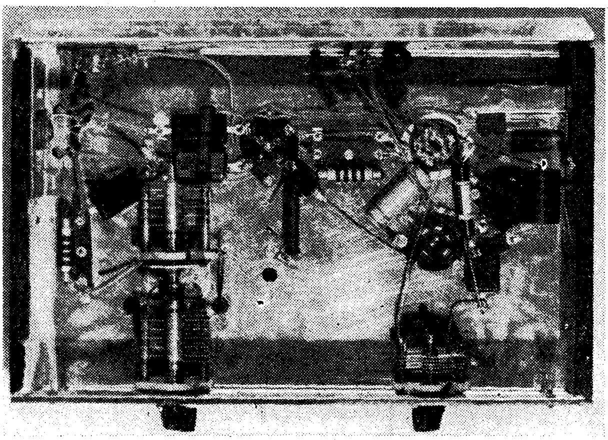
Before adopting this oscillator circuit, we spent a good many hours playing with regenerative circuits in order to find out their advantages and disadvantages. Our final conclusions are that such circuits are quite all right—particularly the circuit which uses a common condenser to ground the crystal and the plate tank coil. But they do take very careful handling, and particularly the beginner is likely to tie himself into some terrible knots trying to make them talk sense.

We found it impossible to strike a value of feed-back condenser which would allow good harmonic output without giving too much coupling when used on the fundamental. By making the coupling condenser variable, our troubles were almost eliminated in this regard, but an extra control was added with still the possibility of getting things out of control. And we found that crystal current can rise high enough under certain circumstances to considerably heat our Bliley crystals. Lower quality crystals would certainly be in danger of fracturing under such conditions.

Whereas in the circuit we have used, at no time is the crystal subject to abnormal current outside the capabilities of a good "rock" and there is no need for the extra control when using the fixed cathode coil. We feel sure that the uses of regenerative circuits, except in experienced hands, can only bring unnecessary headaches. Particularly as in this circuit used here no trouble was experienced in driving the 809 efficiently at any frequency.

The ordinary circuit using a single-section tank condenser in the 6L6G plate circuit has its rotor plates at high potential. This means the possibility of getting a "bite" from the shaft or indicator grub-screw, and the necessity of insulation from the chassis. To avoid this, we have included in the low potential end of the coil a fixed mica condenser of .01 mfds. By doing this we can mount the condenser direct to the metal panel and as a result construction is simplified. A good mica condenser of this capacity should have no trouble in handling the R.F. current flowing in the tank circuit. Circuit efficiency is exactly the same with this connection, as it is with the normal method.

Apart from these points, the oscillator hook-up is straight going, and there is nothing more to worry about here.



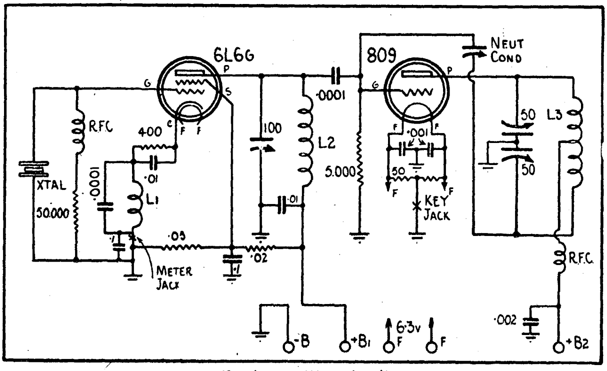
Under the chassis. The fixed cathode coil is at the right. Note the ganged condensers used for tuning the final tank circuit.

THE 809 FINAL STAGE

A conventional circuit is used for the final stage. This uses a Radiotron 809, which, in many ways, is the ideal amateur transmitting valve. It will take an input of 50 watts and more with the greatest of ease—in fact, experimenting, we have employed more than 100 watts input with no color on the plate. It is very robust, and has a high efficiency on all frequencies. Lastly, it is not hard to drive. Its 6.3 volt filament allows us to use a single filament winding for both valves in the transmitter.

The coupling to the 6L6G is by a fixed condenser of .0001 mfds. The bias for the 809 is obtained from a grid resistor from the grid of the valve to earth. Sometimes an R.F. choke is used in series with the grid leak, but we didn't find that it made any difference, so we did not include it.

The standard value for this resistor



The transmitter circuit.

PARTS REQUIRED FOR TRANSMITTER

Chassis, 15 x 9 x 3½.
2 50 mmfds. double-spaced midget condensers (Raymart).
1 100 mmfds. midget condenser.
1 50,000 ohms 1 watt resistor.
1 50,000 ohms 3 watt resistor.
1 20,000 ohms 10 watt resistor.
1 5000 ohms resistor, 50 mills.
1 400 ohms resistor, 100 mills.
1 50 ohms C.T. filament resistor.
2 .1 mfd. 400 volt tubular condensers.
2 .01 mfd. mica condensers.
2 .001 mfd. mica condensers.
1 .002 mfd. mica condenser.
1 .0001 mfd. mica condenser.
2 R.F. chokes.
2 Jack type stand-off insulators.
2 Small stand-off insulators.
Sockets—1 octal, 1 4-pin, 2 5-pin.
Coil formers, copper tubing, indicating knobs, etc.
2 Jacks.

is 5000 ohms, at which value it gives the right grid bias when approximately 30 mills are flowing in the grid circuit. This value may be increased to 7500 ohms or even 10,000 ohms if the 809 is used consistently as a doubler. However, we have used 5000 ohms in this case, as the transmitter so far has been used mainly on 20 metres.

THE SPLIT-STATOR

A split-stator tuning condenser is used in the final tank circuit. As with the tuning condenser for the 6L6G plate, we have mounted it underneath the chassis. This is very convenient, and allows the control to be brought out on the front panel. One of the advantages of the split-stator method is that it leaves the rotor of the condenser at earth potential, and the two Raymart 50 m.m.fds. condensers we used can be mounted direct to the chassis. A stout bracket of 16 guage aluminium supports the second condenser, which is connected to the first through a flexible coupling.

The leads from the fixed plates of the condensers run through holes in the chassis up to the ends of the plate or tank coil, which is plugged into stand-off insulators. Use good, solid rubber grommets for these holes, make the connections with stiff wire, about 14 gauge if possible, and space them so that they are not in contact with the rubber. This isn't essential, but it guards against any possibility of leakage.

THE POWER SUPPLY

The power unit is divided into three sections. The first is the filament transformer, which supplies 6.3 volts for the transmitter filaments, and 5 volts for the rectifier. There is no reason why a couple more windings should not be placed in this transformer, as there is plenty of room for them, and it will enable you to play round with other valves from time to time should you desire to experiment.

The second unit is the filter choke to carry 175 mills.

The third unit is the high tension transformer. This has an output of 600 volts per side at 175 mills. This rating is required because the final stage may run anything up to 100 mills, and the oscillator will take approximately 60 mills. There are no filaments on this transformer. It is essential to be able to switch it off without affecting any filaments, and in any case the practice of placing filament windings on the power transformer isn't a good one when voltages as high as 600 are concerned.

FILTER CONDENSERS

The filter condensers are 2 mfds. electrolytics of the Solar 600 peak volt type, two being connected in series for each side of the choke. We have omitted the usual resistors across the condensers which are really preferable when they are used this way, because the voltage across each is only about 300, and these resistors are essential only when the working voltage approximates the maximum allowable for the condensers. However, .25 meg. resistors may be connected across each condenser if desired.

The rectifier is an ordinary 5Z3. Three switches are used for the transmitter. One is a master switch, which energises the filament transformer for a start. The second switches in the high-tension, and this latter cannot be turned on before the master switch is in action, so you can't turn on high tension without knowing it. A third switch is used to break the high tension to the final, used really only for testing, and not normally operated when the transmitter is in action. Good switches are quite essential here.

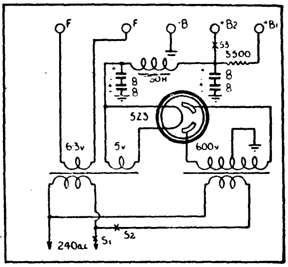
A five-way cable connects the power supply to the transmitter. We have made it to plug into both chassis for convenience. If only one plug is used, keep the socket on the power unit, so that you can't possibly have live prongs lying round if the power supply should be turned on while not connected to the transmitter.

NEUTRALISING CONDENSER

We made our own neutralising condenser in a very simple fashion, by cutting two plates from aluminium sheet, and mounting them on two stand-off insulators. Washers are used to maintain spacing between the plates, which can be operated by swivelling the top one with a stick of wood. Such a condenser is very easy and cheap to make, although a manufactured type can, of course, be used with equal efficiency. Our close-up photograph shows the construction of this little condenser. The plates may be about 1½ inches by 1 inch in size, and spaced about 1-16th of an inch.

CONSTRUCTIONAL

Several points in the construction of the transmitter are worthy of mention.



The circuit of the power unit.

PARTS REQUIRED FOR POWER UNIT

Chassis, 15 x 9 x 3½.
Power transformer, 600-0-600 at 175 m.a.
Filament transformer, 5v. 3a., 6.3v. at 35a.
Filter choke, 30 H. at 175 m.a.
4 600-volt peak 8 mfds. electrolytic condensers.
3 Switches.
1 3500 ohm resistor, 80 mills.
3 Switches.
Sockets—1 4 pin, 1 5 pin.

The chassis were cut from aluminium, bent to size, and fitted with wooden ends about ½ inch thick. Apart from the convenience of being able to "rock-mount" such chassis on wooden uprights, the wooden ends tend to stiffen the metal. Any number of such chassis may be mounted one above the other, by running through the upright's ordinary wood screws, which penetrate the wooden ends. In our case we used about 2 x ½ inch wood for the front uprights, and ½ inch square for those at the back.

The jacks are mounted on bakelite squares screwed to the insides of the wooden ends. One-inch holes through the sidepieces are cut for these with an ordinary wood bit. The meter for checking plate currents may be plugged into these jacks without cluttering up the front panel. Incidently a 0-150 mill. meter may be mounted on the front panel of the transmitter if desired, and it will serve equally well for each stage.

The jack in the centre-tap of the 809 filament may be used to read its plate and grid current, or by breaking the high tension lead with the switch, it will indicate the grid current alone. This jack is also used for the key, as the American practice of keying crystal oscillators, while it has much to recommend it, demands the use of very good crystals.

The bakelite panel we used for the front of the transmitter chassis was placed there for appearance—it is quite permissible to use the plain metal, as the condensers are in contact with it anyhow.

The coils for the oscillator plate circuit are wound on ordinary formers. It is not easy to get formers which will stand 50 watts input for the final stage, so we have used plug-in coils made of copper tubing. The coil shown is made of 3-16 copper, but ¼in. tubing is in some ways more suitable, and should be used for the 40-meter coil. The 80-meter coil may be wound with lighter gauge wire, on a former, to which a couple of plugs are attached.

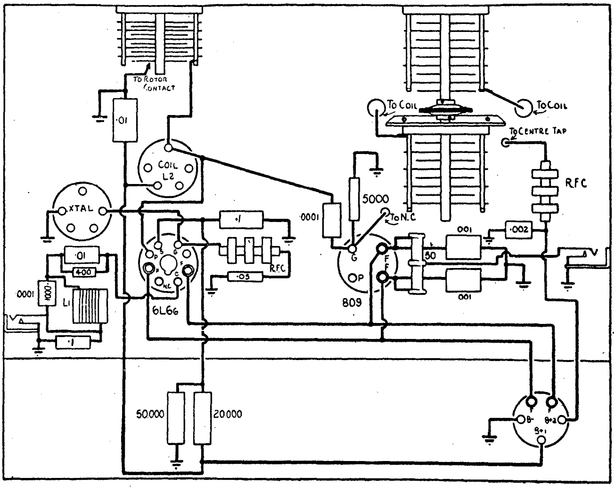
The coils themselves plug into a pair of Birnbach stand-off insulators. Another advantage of using the tubing is that the coils are self-supporting, and are very hard to damage. They are all centre-tapped for neutralising, and if these taps are made accurately, the same neutralising setting should suit for all bands.

Most of our testing has been done with a 20 metre matched impedance feed aerial, but the aerial tuner panel carries a couple of condensers if tuned feeders are used. Any of the standard aerials may be employed, according to taste. We suggest link-coupling the final stage to the aerial tuner. Ordinary hook-up wire will be sufficient for the link, although rather heavier gauge rubber-covered cable would probably be a little better.

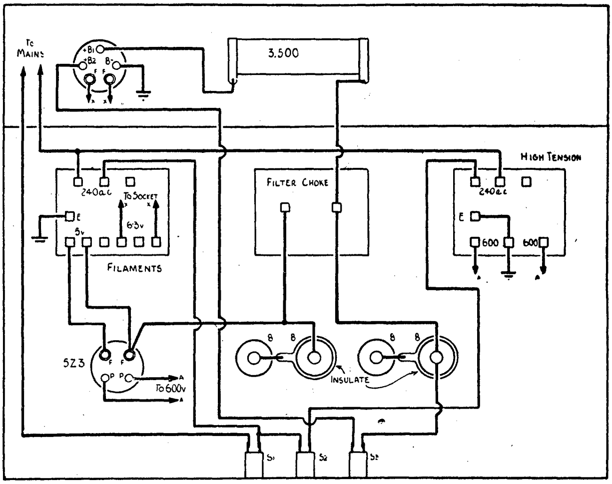
OPERATION

It is quite easy to get the transmitter in operation. Having made sure that all the components are correctly wired, and that the hook-up is correct, turn the filaments on. Allowing a few seconds for the 6L6G to warm up, switch on the power. Have on hand the usual test loop, consisting of a single turn of wire and a pea-lamp. Bring this close to the top of the oscillator plate coil and it should light brilliantly when the plate condenser is tuned to resonance, which will probably be about half to quarter way out of mesh. Tune for maximum brilliance.

Now for neutralising. Set the neutralising condenser plates about the same amount as those in the photograph, and tune the 809 plate coil through resonance. The lamp indicating output from the 6L6 will probably dip as you run through this resonance point. The idea is to adjust the movable plate of the neutralising condenser until you can tune through this point with no change in this lamp's brilliance. The position of the plate will be reasonably critical, so take care over it. Push it a little at a time with a piece of wood, until the dip begins to get less and less pronounced. Probably you will need to readjust the 6L6G plate condenser from time to time to keep the stage in tune. When finally you get a setting which will allow you to tune through resonance without any



The wiring diagram of the transmitter.



The wiring diagram of the power unit. S1 is the master switch, S2 controls the high tension, and S3 can be used to break the voltage to the final stage.

change in the lamp's brilliance, the stage is neutralised.

A further check is to plug the mete. into the final circuit jack, with the plate voltage turned off (as it has been all the time, of course) and tune the plate tank condenser for maximum reading. This will be the grid current, and should be about 30 mills or so. As you tune the plate tank condenser through resonance, there should be no change in the grid current.

Having made sure of the neutralising, see the tank condenser at the spot approximately the same as the spot where the dip originally occurred, so that it will be somewhere near resonance, and turn on the final high tension. Tune the tank condenser quickly until the meter reads the least possible current. On 20 and 40, this will be about 40 mills or so, remembering that this meter reads grid and plate current combined. If the tank condenser should be tuned out of resonance, the meter should kick well over towards the 150 mill mark, and the plate will run red-hot. Naturally, one doesn't do this as a regular thing!

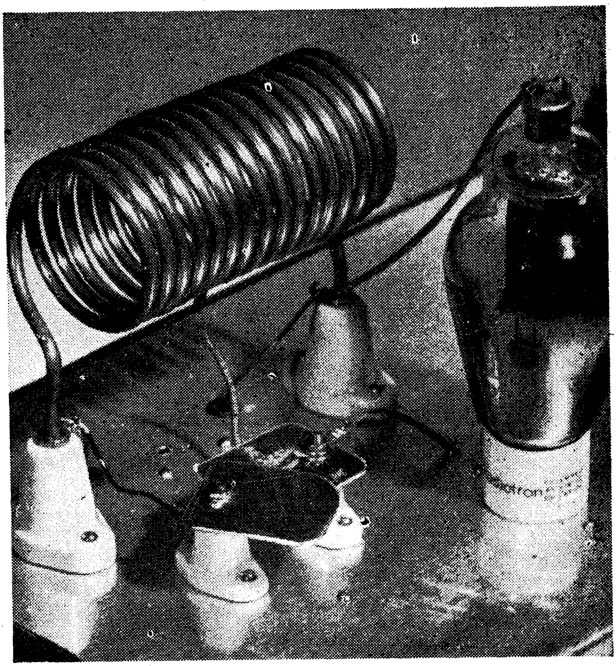
The unloaded plate current of the final, allowing for a couple of mills grid current less when the high tension is on, should be between 10 and 15 mills in resonance, on 40 and 20 metres, while on 10 metres, it will be somewhat higher —about 25 mills. In all cases the stage may be loaded up to 100 mills with safety when the aerial is connected. Don't forget that the meter in the filament circuit will be reading about 30 mills of grid current as well as the plate current, so that the total reading will be about 130 mills maximum. At this reading, no color whatever should show in the 809 plate.

The neutralising and tuning procedure is the same no matter what the band used may be. Naturally, neutralising will only be possible when the valve is acting as an amplifier.

COIL DATA

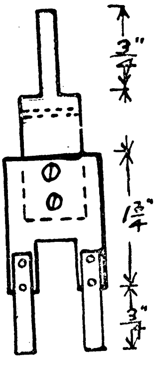
The coils for the 6L6G oscillator are wound as follows: The 40-metre cathode coil has 20 turns of guage 20 enamelled wire wound on a 1-inch former, spaced over 1 inch. The 40-metre coil for the plate circuit has 20 turns of the same wire on a 1¼-inch former spaced over 1½ inches. The 20-metre coil has 10 turns on a 1¼-inch former spaced over 1½ inches.

The 40-metre plate coil for the 809 is made of ⅛-inch copper tube, and has 30 turns, 2 inches in diameter. For 20 metres, use 16 turns of 3-16th tubing the same diameter, and for 10 metres, 8 turns of the same tubing. These coils are all centre-tapped, and spaced over a length of 4½ inches. Plugs are fitted to the end so that they fit in the stand-off insulators. All these dimensions should provide quite an accurate guide, but are subject to slight alteration to suit particular cases.



Showing construction of the neutralising condenser. This tank coil of 3-16in. copper tube, is used on 20 metres. One-eighth tubing will probably be more suitable for 40 metres.

AN ANTENNA RELAY



The Paddle

(Continued from Page 36)

THE CONTACT BLOCK

This is V-shaped, and is cut from bakelite or formica ⅜-inch thick. Cup head brass screws form the contact studs, the nuts holding solder lugs on the outside. The gap in this block is ⅜-inch wide, i.e., the paddle blades move through a distance of ½-inch or so. A countersunk screw holds the contact block to the base block, which in our case is a piece of red sheet fibre ½-inch thick and 4 inches square.

The final stage of the writer's transmitter is link coupled to the zepp feeder tuning coil and condenser. This link is broken, and the relay inserted, thus giving tuned antenna input to the receiver via link coupling.

All tube filaments are heated by separate transformers; a telephone type multiple switch supplies 240 volts to the plate transformers when in the "down" position. On moving the switch to the "up" position, the 240 is cut from the plate transformers, and "B plus" is connected to the receiver. The neutral or centre position of the switch cuts both circuits. Thus the whole send-receive arrangement is controlled by a touch of the finger.