FROST HUNTER H-210 (HUNTERFROST H-210)

To be applied for prevention of frost damage in fruit, vegetable and flower growing in the open spaces, and as air heater in greenhouses and closed spaces.

It consists of a gas turbine powered by a tractor of minimum power of 48 kW via propeller with max. 540 r/min.

Gas turbine expands the hot air 140 meters in width and 70 meters on each side.

Gas consumption amounts to 30 - 40 kg/hour; the machine carries 6 bottles, 35 kg each, and can operate 6 hours without a break. It can cover the area of 4 - 8 ha.

A drive plan has to be developed, as it has to come to the same place every 8-12 minutes. The machines has good results at temperatures up to -7°C.

APPLICATION

Prevention of frost damages in fruit, vegetable and flower growing.

ADVANTAGES

- Covers an area 4-8 ha
- Low costs and easy to handle

TECHNICAL SPECIFICATIONS

Length	4100 mm
Width	1650 mm
Height	1670 mm
Weight /without gas/	935 kg
Maximum capacity	4 - 8 ha
Working speed	4 - 8 km/hour
Aisles distance	50 - 80 m
Average gas consumption	30 - 40 kg/hour
Safety standards	EEG/EC
Number of gas bottles	6
Test temperatures	-5 do -7 in specific phases of flowering
Minimum required power	48 kW

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OPERATING & MAINTENANCE INSTRUCTIONS

HUNTERFROST H-210

Application and methods of work HUNTERFROST H-210

- The basic purpose of HUNTERFROST H-210 is a timely protection from frost in the production of fruits, vegetables and grapes
- Additional heating of greenhouses to speed up the collection of the first / begining of the harvest season, or for later collection / harvest at the end of the season
- To improve the yield of fruits during the flowering at low temperatures, and drying fruit after rain

PROMPT PROTECTION FROM FROST WITH HUNTERFROST H-210

The system of work with Hunterfrost H-210 is a dispersion of warm air per plot that we want to defend against frost. Gas turbine in which fan take warm air from the gas burner, blows that warm air at ground surface to 70 meters on each side of the machine.

The appearance of radiation frost implies the occurrence of cooling air discharge energy, and it happens constantly. Thus, warm air coming out of Hunterfrost H-210 is mixed with a certain amount of air and spread on the ground. Due to the warm dry air, it leads to reduced moisture in the mixture of air that rises up to 10 meters in height. Constant supply of warm air creates a barrier height of the radiation frost. To achieve this you need to start working with the unit when the outside temperature drops to $+0,5^{0}$C, and work up to the moment when unheated ambient air temperature is higher than 0^{o}C.

Area that we can defend ourselves from the frost varies from the pitch position and the shape of the parcel. Plot size rectangular shape, which can be protected from frost, much greater than the pitch with a lot of irregular sides. Before start of working with the machine, you need to plan the driving route in advance. To successfully protect a parcel from frost you must come to starting point every 8 to 10 minutes, and so by circling the plot until the danger of frost has passed (when surrounding unheated air temperature is higher than $0,5^{o}$C.

The parcel that you need to protect from the frost, first you must record by driving the tractor (at speed of 4-8 km/h) to determine aisle so that the circle passes and coming to the starting point within 8 to 10 minutes. The recorded aisles (passes) you must marked with boards and numbering sequence of the passage, so when you go with machine to defend the parcel from frost, you just follow the signs and close the circle passes on time, because any longer passages brings greater risk of hypothermia and frost damage.

REHEATING GREENHOUSES AND PLASTIC TUNNELS WITH HUNTERFROST H-210

Many producers of fruit, vegetables and flowers, carries out their production in greenhouses and plastic tunnels (plastic greenhouses). Due to weather conditions, very often there is a situation of a very cold and long winters, and very early autumn chill. Because of these situations, it comes to a slow plant growth, resulting in a substantial delay of planting vegetables or flowers pruning, which can cause significant financial losses.

Hunterfrost H-210 is the ideal solution for these problems. Since the machine is banned in any enclosed space, because of the above mentioned reasons, the additional heating of greenhouses is done with the work of the machine in front of such objects. The machine is set so that the outlet pipe from the turbine is directed through the door into the greenhouse or plastic greenhouse. If objects have opposite door, then focus on hole through the door, and the other must be directed to an open area, so there is a distance of minimum 30 meters from any bulidings or obstacles. Due to the large displacement of warm air, and fan (blower) range up to 100 meters, by mixing of air you can relatively fast reach the required temperature in reheated area (space), and when necessary, to maintain it constantly in certain range of determinated values. If you have multiple objects that you need to warm up (reheat), than plan the passage of tractor and machine, and when you reach the needed temperature in one object, you go to another object without stopping the machine, and so on until you have reheated all desired objects. If you preheat only with one side of the machine, always use lower exhaust stream of warm air.

YOU MUST OBEY ALL SAFETY AND PROTECTION MEASURES, AS YOU OBEY WHEN WORKING ON PROTECTION OF OUTDOOR PARCEL FROM THE FROST.

DRYING THE FRUITS AFTER THE RAIN WITH HUNTERFROST H-210

After heavy rain and rapid arrival of the sun, on many fruits in the orcharding comes to fruit cracking which leads to rotting of fruit, poor quality and financial losses. By using the Hunterfrost H-210 after the rain, you are brining warm air on fruits and leaves of fruit trees, and due to the velocity of warm air flow, it comes to heating and rapid drying of fruits, thereby preventing cracking of fruits and higher losses.

YOU MUST OBEY ALL SAFETY AND PROTECTION MEASURES, AS YOU OBEY WHEN WORKING ON PROTECTION OF OUTDOOR PARCEL FROM THE FROST.

SAFETY PRECAUTIONS BEFORE USE OF HUNTERFROST H-210

IT IS STRICTLY FORBIDDEN TO USE HUNTERFROST H-210 IN INDOOR / CLOSED SPACES BECAUSE OF THE FOLLOWING SITUATIONS:

- The tractor engine and burner of machine consume a lot of oxygen.

- The tractor engine by combustion produces carbon monoxide, a toxic gas
- The possibility of a gas leak from a gas bottle

For a safe use and work with Hunterfrost H-210, it is necessary to exclude all possible situations that might endanger or jeopardize the workers on the machine or any other person close to the machine.

1. When operating machine, the safety zone is 30 meters, which means that during startup, operation and shutdown of the machine, there can not be any other person in this area except the operator of the machine.
2. To connect the tractor with the machine, on lower coupling lever of tractor drawbar thickness minimum 25 mm, and all connecting bolts must be secured with suitable fuses against fallout.
3. Driveshaft of gearbox (transmission) connects to the output shaft of tractor by cardan (PTO), which must be adjusted lengthwise so that is neither long nor too short, and the plastic protectors on the cardan must be fastened to the both side, so that when you engage PTO, plastic guards are in place and they don't rotate with the cardan (gimbal).
4. Driveshaft of gearbox (transmission) must be protected with the shield which is delivered with the machine.
5. Gas cylinder must be in place on both sides and it required all the cylinders (bottles), that is, on each side for 3 cylinders (bottles). After closing the door on the box with gas cylinders, each bottle must be strengthened with tightening belts for rear extension box bottle.
6. By consolidating the gas bottle, hook up all the flexible hose connecting on the bottle valves. With each new connection you must always perform a merge with new gaskets. After the merger, it is necessary to check possible gas leaking, ie, open all valves on the bottles and with leak spray (or some kind detector for gas) check is there a gas leaking somewhere.
7. Box with the control panel should be fixed in the tractor cabin, so it can always be in the driver's field of vision, and that the switches on the control panel are within the reach of the driver. The electronic power supply of control panel should be connected to the appropriate socket on the tractor's dashboard, and by switching on the main switch check for correct power supply of control panel.
8. Before connecting the machine to the tractor, it is necessary to check if tractor is working properly, ie, you have to check turning on and turning off the drive shaft (PTO), is there enough amount of fuel in the tank, if lights are working properly, etc.
9. If the parcel (field) is more skewed, due to stability of machine it is possible to expand the driving lane of the machine. External lane of machine is 165 cm, and it may be increased to a maximum of 205 cm, which is 20 cm on each side.

SAFETY PRECAUTIONS DURING USE OF HUNTERFROST H-210

For safe use and operation with Hunterfrost H-210 it is necessary to follow next instructions:

1. When the machine is in use (working) make sure that no one is within the safety zone of 30 meters around the machine.

2. Make sure that you have clear view on the passages as well as on control panel while working, and with no objects that are blocking your view.
3. If you need to get out of the tractor due to unforeseen circumstances, be sure to leave output shaft (PTO) in on position, rotating at the operating speed, because if you reduce the speed of output shaft (PTO), there will come to a significant increase of temperature in turbine, which may lead to burnout of indicators and potential hazard of of ignition.
4. In the case of stopping, never stop between the trees, but preferably stop the machine outside the rows of orchard.

SAFETY PRECAUTIONS WHEN ENDING WORK OR CHANGING THE GAS BOTTLES WITH HUNTERFROST H-210

For the safe completion of work with Hunterfrost H-210, it is necessary to follow these guidelines:

1. On completion of work, on the control panel, turn the main valve (no. 10) to the right (OFF). Then the control light (no. 3) will light up (EMV – electro magnetic valve) which indicates that EMV is closed and the flame on the burner is automatically extinguished. Now you have to wait 2-3 minutes for fan, which is running at the same speed (RPMS) to cool down the turbine and the temperature sensor. After temperature falls, gradually reduce RPMS to minimum and turn off the driveshaft (PTO). After that close the front manual valve (PV), and close all the valves on the gas cylinders. Now turn off the power with the main switch on the control panel.
2. If we are done with work, disconnect all gas cylinders, remove them from the machine and place it at outside storage site, and storage the machine in a covered and a dry place. If we must continue with the work, after removing the empty gas cylinders, put back on full gas bottles, connect hoses on the valves of bottles with the new rubbers, open the valves on the bottles and check for gas leak with spray leak. After closing the door on a box with bottles, each bottle must be strengthened with tightening belts for rear extension of bottle box. We can then repeat burner ignition sequence, set to a given (default) temperature and continue with the work in orchard. Time needed for changing the gas bottles (cylinders) must be as short as possible. It is recommended that this is within 10 minutes.

SAFETY PROCEDURE FOR STARTING UP HUNTERFROST H-210

CONTROL PANEL

1. The main switch = with this switch turn on and turn off the machine
2. White light = if the light is lit, the machine is switched on
3. Green light = if the light is lit, the electro magnetic valve (EMV) is closed
4. Green light = if the light is lit, the front manual valve (PV) is closed
5. Green light = if the light is lit, the rear manual valve (SV) is closed
6. Yellow light = if the light is lit, the electro magnetic valve (EMV) is open
7. Yellow light = if the light is lit, the front manual valve (PV) is open
8. Yellow light = if the light is lit, the rear manual valve (SV) is open
9. Thermometer = shows the current operating (working) temperature
10. Manual switch = this switch controls the electro magnetic valve (EMV) and must be kept in the ON position while the valve is left open automatically (until the blue light 11 is off)
11. Blue light = if the light is lit, the electro magnetic valve (EMV) is open automatically toward heat sensor and manual switch 10 can be released
12. Emergency stop = the button (switch) must be pressed (turn on) in case of emergency; the electro magnetic valve (EMV) will closed immediately and the burning process will be stopped

13. The fuse = protects the (power) circuit against short circuit

It is very important that the initialization process is performed by one person.
It could be very dangerous if a few people together try to start the machine.

1. Start the tractor.
2. Switch the main switch (1.) to ''ON'' position. The white indicator light (2.) will light up. If this does not happen, check the connection that connects the control box on the tractor. The three indicator lights (3., 4., 5.) will light up if both manual valves (PV, SV) and electro magnetic valve (EMV) are closed. If this is not the case, please close the manual valves. Thermometer (9.) will show the current operating (working) temperature.
3. Open all gas bottles (cylinders).
4. Remove the protective cover on the rear end of the machine, only when the three green indicator lights are light up (see picture below), and when you are wearing protective clothes.

If one of the three green indicator lights is not lit up, there's a possibility of gas leaking in the pipe. Remove the lid (cover), turn the flame on and put it into the space below the burner.

5. Open the manual valve (SV) on the rear end, and the manual valve (PV) on the front end of the machine. Make sure that the all gas cylinders are fully open.

6. After checking the minimum safety distance of 30 meters around the machine for the presence of other people, go back to the tractor. The two of the three yellow indicator (signal) lights (7., 8.) on the control panel should now be lit. If not, check again that the manual valves are open.
7. Turn the manual switch (10.) on the control panel to the right (ON) and hold it in the ON position. Electric valve opens and the burner will start to burn. If this does not happens within three seconds, you must turn off the switch, allow the machine to purify (clean) from the gas and continue with the starting procedure from point 6.
8. When the burner is turned on, the fan should be running in the shortest time. Gradually accelerate PTO up to maximum of 540 rpms.
9. The temperature on the thermometer (9.) will be on the rise, and when the blue indicator light (11.) on the control box (bord) lit up, you can release the manual switch (10.). The blue light indicates that the electric manual valve (EMV) stays open automatically.
10. If the temperature exceeds 120^{o}C, the electric manual valve (EMV) shuts down (closes) automatically, and if it does not close automatically, you must turn the main switch (10.) to the left (OFF) or press the emergency stop button, and by closin the electric manual valve (EMV) shut down the burner. Let the fan run for few minutes until the machine has cooled down, lower the pressure of the gas and start the procedure again from the point 6.
11. Check the temperature and adjust the gas pressure to obtain the temperature between 85^{o}C and 100^{o}C. If the temperature remains stable for several minutes, you c<n begin to drive through orchard, etc.
12. When the machine is working (operating), the fan speed can not be raised or lower under any circumstances. This means that the drive shaft has to be performed with a steady pace. Any change will have a direct impact on temperature. If the temperature exceeds 140 ° C, a temperature sensor that controls the operation of the machine can burn out. In this case the operation of the machine will not be possible.

IMPORTANT WARNING

On the control panel next to the driver is a emergency stop button. If there is any doubt, the button must be pressed. All gas supply will be immediately terminated.

When the machine is operational (working), the fan speed can not be raised or lowered under any circumstances. This means that the drive shaft has to be performed with constant work of output shaft (PTO) tractor at 540 rev. / min. Any change will have a direct impact on the operating temperature.

When interruption of gas supply, for whatever reason, always keep machine in operation for another three minutes to remove the accumulated gas and to cool down the temperature sensor. Only then other people can get into the safety zone.

When the machine is transported, gas cylinder valves must be closed the whole time.

USEFUL TIPS

- Start the drive shaft gradually.
- When the temperature on the control panel drops for 20°C in just a few minutes, the gas cylinders will have to be replaced. In this case, the timetable may be interrupted for a few minutes, without possible damages to the plants. It is advisable to replace the gas cylinders as quickly as possible, under 10 minutes.

THE IDEAL CIRCLE PASSES WITH HUNTERFROST H-210

The ideal distance between rows through which you are driving during the operation (work) with Hunterfrost H-210 is 50 to 80 meters. If possible, don't always go through the same rows, but first go through the left row, then go through the main row, and then turn to the right, so you have 3 rows through which you are driving. This is better because of the air distribution, it will cause less drying of flowers and keep the soil in the better condition. If the distance between the rows is greater (bigger) than 4 meters, you can use 2 rows for passage instead of 3. If possible, drive 2 laps alternately. The second round (lap) should go through the middle of the first round, or at least 25 meters to the left or right of the first round. The total circuit length shall not be more than 1300 meters, and if you drive 2 laps, the total length of the second passage (lap) must not be greater than 2600 meters.

The driving speed must be between 4–8 km/h, and should be paced in a way that one lap (round) lasts between 8 and 10 minutes.

Make a test drive with mounted gas cylinders, with running fan operating at tractor's PTO speed of 540 rev./min, at a speed of 4-8 km/h with a extinguished (turned off) burner. This is very important because you will be able to pre-plan to circle (lap) passes at any given time during the closing laps of work. The pre-planed circles (laps) passes and directions of laps by rows mark with numbers and labels, so when to conditions for defence of frost appears, simply plug the machine and start working (driving) by planned labels.

WHEN TO BEGIN AND FINISH WITH WORK

In the case of night frost, you should start with work when temperature drops to 0,5°C. The machine should work approximately 1 hour before it starts to create a positive impact on temperature and humidity (moisture). As soon as the temperature outside the orchard is positive, you can stop working.

DURING THE WORK OF HUNTERFROST H-210

There are three factors that are essential to the performance of the machine:

1. Increasing the temperature
2. Increase in fluctuating temperatures, ie. at each passing with the machine, the temperature is slightly raised and then falls again. The advantage of the fluctuations

is that it requires much less energy than a constant temperature rising above the critical value. Therefore, the input of energy is seven times less than at other systems.

3. The greatest damage during the night with frost is caused by ice crystals. Wherever Hunterfrost H-210 is used, the relative humidity (moisture) is significantly lowered, and thus the creation of ice crystals will start much later and will be in much smaller quantities. The result of the operation of the machine: - no or very little damage.

REQUIRED EQUIPMENT WHILE WORKING WITH HUNTERFROST H-210

When working with a Hunterfrost H-210 each user must use the equipment both for their own safety and for the safe operation of the machine. Therefore, when working with the machine, the user needs to use the following equipment:

- Protective gloves for hands
- The protective gas mask for face

From accessories for safe operation with the machine, it is necessary to use the following:

- Tightening straps for attaching a gas bottles to the machine (50 mm x 1,500 mm - 6 pieces)
- Spray to check for leaking of gas valves on the bottles
- Connecting shaft of sufficient length toward the type tractors and power output shaft
- Rubber gaskets for valves connections and gas cylinders
- Cubes for kindling the burner
- Matches or some other lighter for cubes
- Appropriate keys for connection of valves to cylinders and pressure adjustment on the valve of the gas flow towards the burner

MAINTENANCE OF HUNTERFROST H – 210

Maintenance of the machine itself is very simple and does not require large financial costs. From routine maintenance requires the following:

- Every 10 working hours is necessary to lubricate (greased) the front bearing on the shaft of the gearbox (transmission) joint with drive shaft (cardan)
- Every 150 working hours or after two (2) years, whichever comes first, it is necessary to change the oil in the gearbox (transmission), and with oil HIPENOL 80W90. The volume (amount) of oil is about 2 liters ± 0,5 liters
- All the hoses on a gas installation should be changed after every 4 seasons working with the machine

All other maintenance is to clean the dust that will fall on the machine in the storage space, which has no direct impact on the operation of the machine. At the first use of the machine in the season it is necessary to clean up with a clean cloth the holes in the burner of the machine.

WARRANTY OF HUNTERFROST H-210

The warranty covers all parts of the machine that are faulty from the start of purchase, and are produced in the company ''HITTNER d.o.o.'' and warranty is given on 2 years from date of purchase of machine. This warranty does not apply in the case of normal wear, when the fault has been caused by improper use or maintenance of the machine, if the user has not observed the instructions in the manual, or when non genuine/original parts are mounted on the machine, and which are not manufactured in the company "HITTNER d.o.o.".

The warranty is not valid if the user does not have a certified receipt of the machine, as well as a certified warranty from the company "HITTNER d.o.o.''.

SERVICE AND REPAIR OF HUNTERFROST H-210

To service the machine and replace any spare part on the machine with a warranty and after the warranty period, the customer service of "HITTNER d.o.o.'' is authorized.