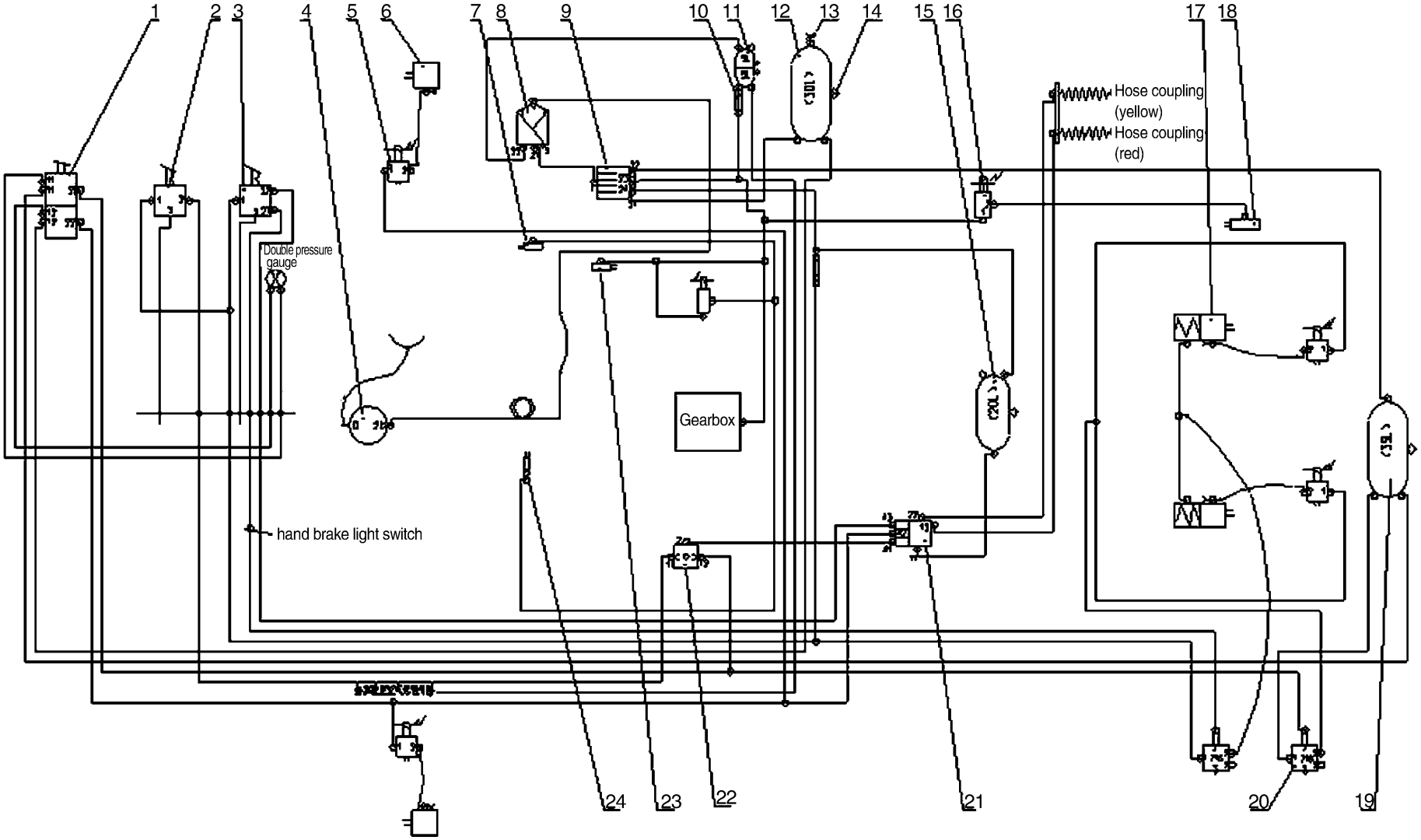
SECTION 3 AUTOMOBILE BRAKING SYSTEM AND THE ENTIRE VEHICLE AIR PIPELINES

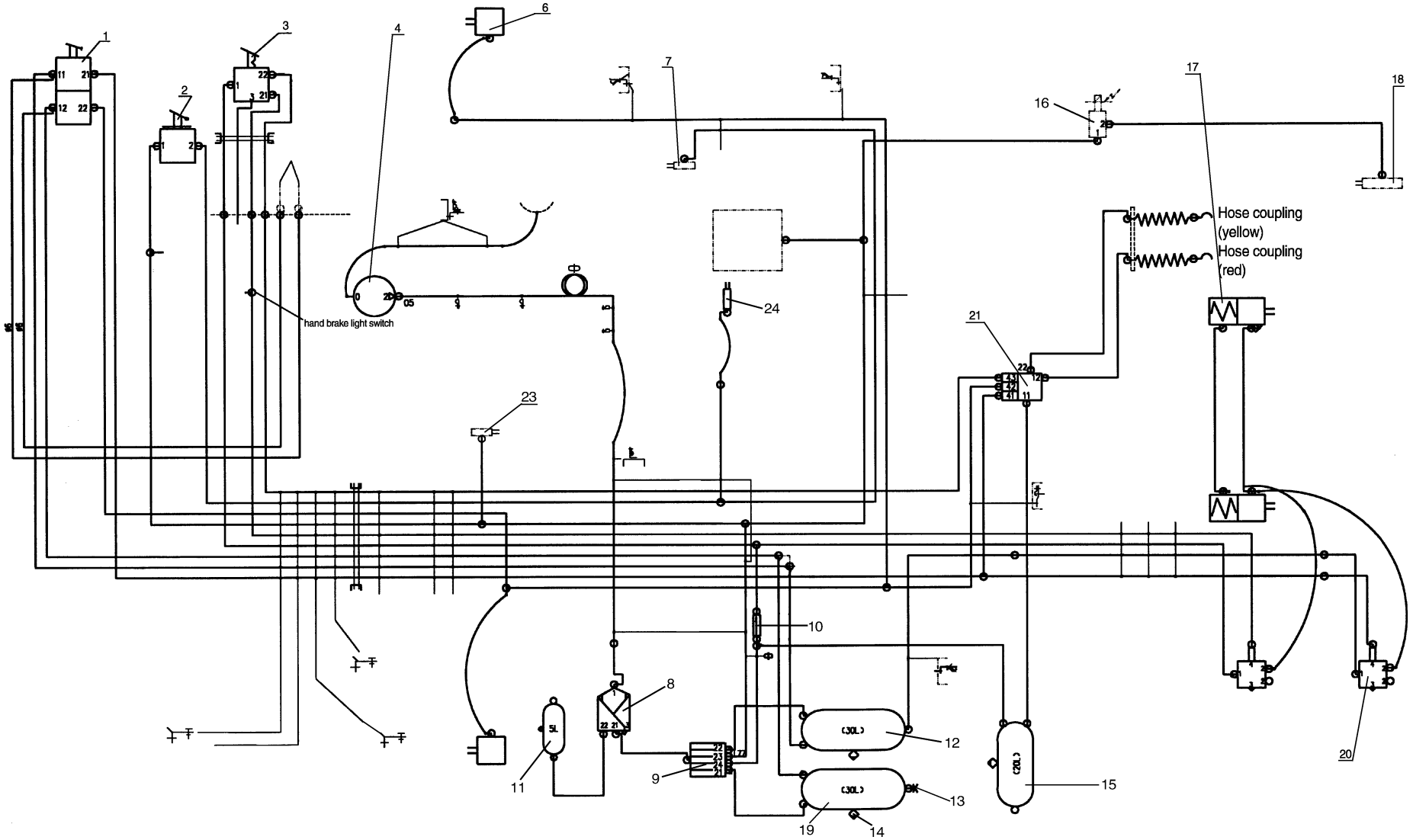
- The braking systems and entire vehicle air pipelines vary slightly based on different drive forms and vehicle models. Fig. 12-2, Fig. 12-3 and Fig. 12-4 are braking air pipeline schematic diagrams for various drive types of automobiles.



1. Main brake valve
2. Trailer hand brake valve
3. Hand brake valve
4. Compressor
5. ABS electromagnetic valve
6. Chamber brake cylinder
7. Fuel cutout cylinder
8. Air dryer
9. Four circuit protection valve
10. Return valve
11. 10L Air reservoir
12. 30L Air reservoir
13. Test head
14. Drain valve
15. 20L Air reservoir
16. Electro magnetic valve
17. Chamber spring brake cylinder
18. Oprating cylinder for diffrential lock
19. 35L reservoir
20. Relay valve
21. Trailer control valve
22. Daul return valve
23. Aux.cylinder for gear box shifting
24. Exhaust brake cylinder

Explanation for marks: 1/11/12 –– Air inlet, 2/21/22/23/24 –– Air outlet, 3 –– Breathing hole, 4/43 –– control port.

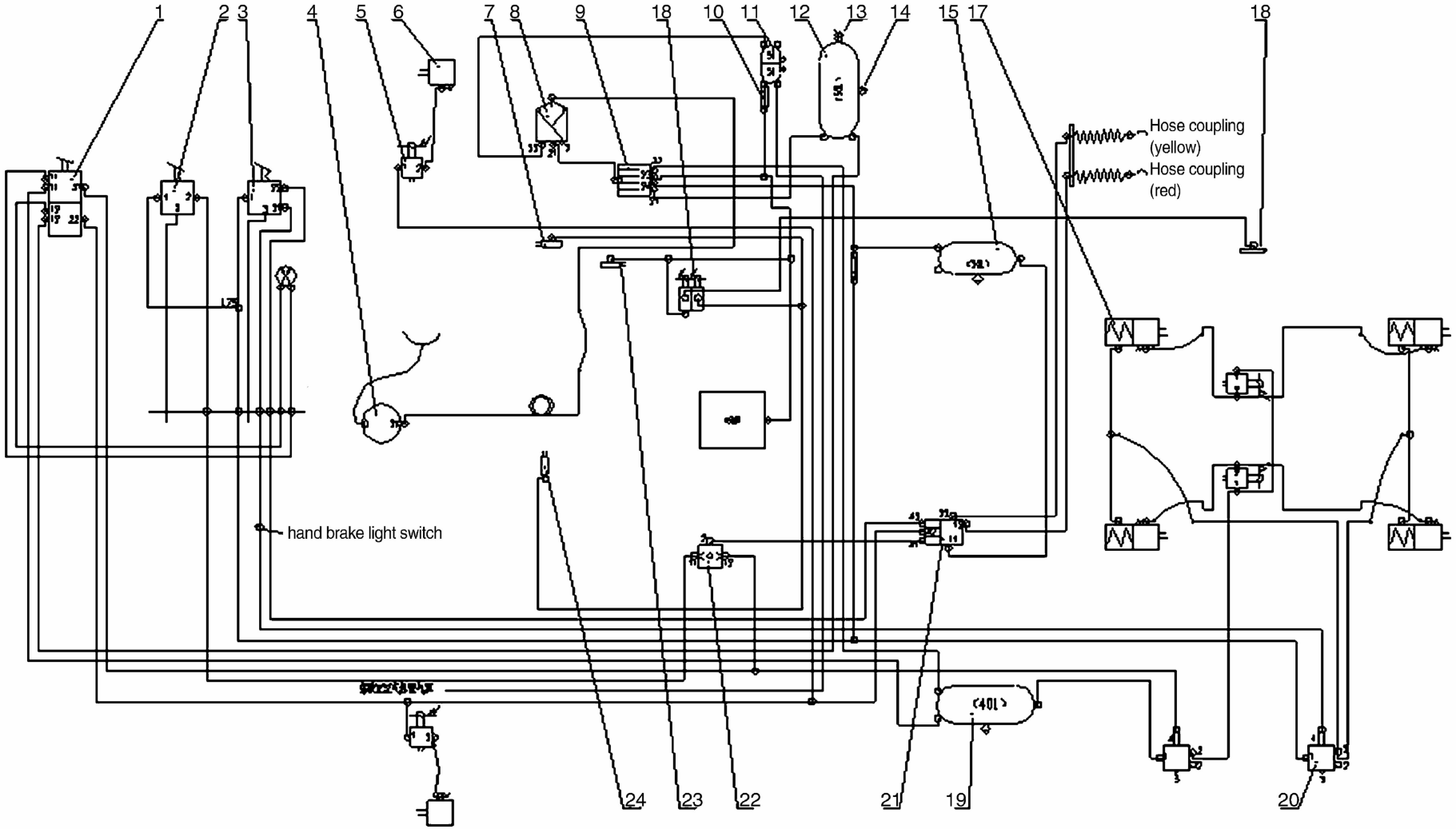
Fig. 12-2 HOWO 4×2 Tractor braking system diagram



1. Main brake valve
2. Exhaust brake valve
3. Hand brake valve
4. Compressor
5. ABS electromagnetic valve
6. Chamber brake cylinder
7. Fuel cutout cylinder
8. Air dryer
9. Four circuit protection valve
10. Return valve
11. 5 L Air reservoir
12. 30L Air reservoir
13. Test head
14. Drain valve
15. 20L Air reservoir
16. Electro magnetic valve
17. Chamber spring brake cylinder
18. Oprating cylinder for diffrential lock
19. 30L reservoir
20. Relay valve
21. Trailer control valve
23. Clutch brake cylinder
24. Exhaust brake

Explanation for marks: 1/11/12 –– Air inlet, 2/21/22/23/24 –– Air outlet, 3 –– Breathing hole, 4/43 –– control port.

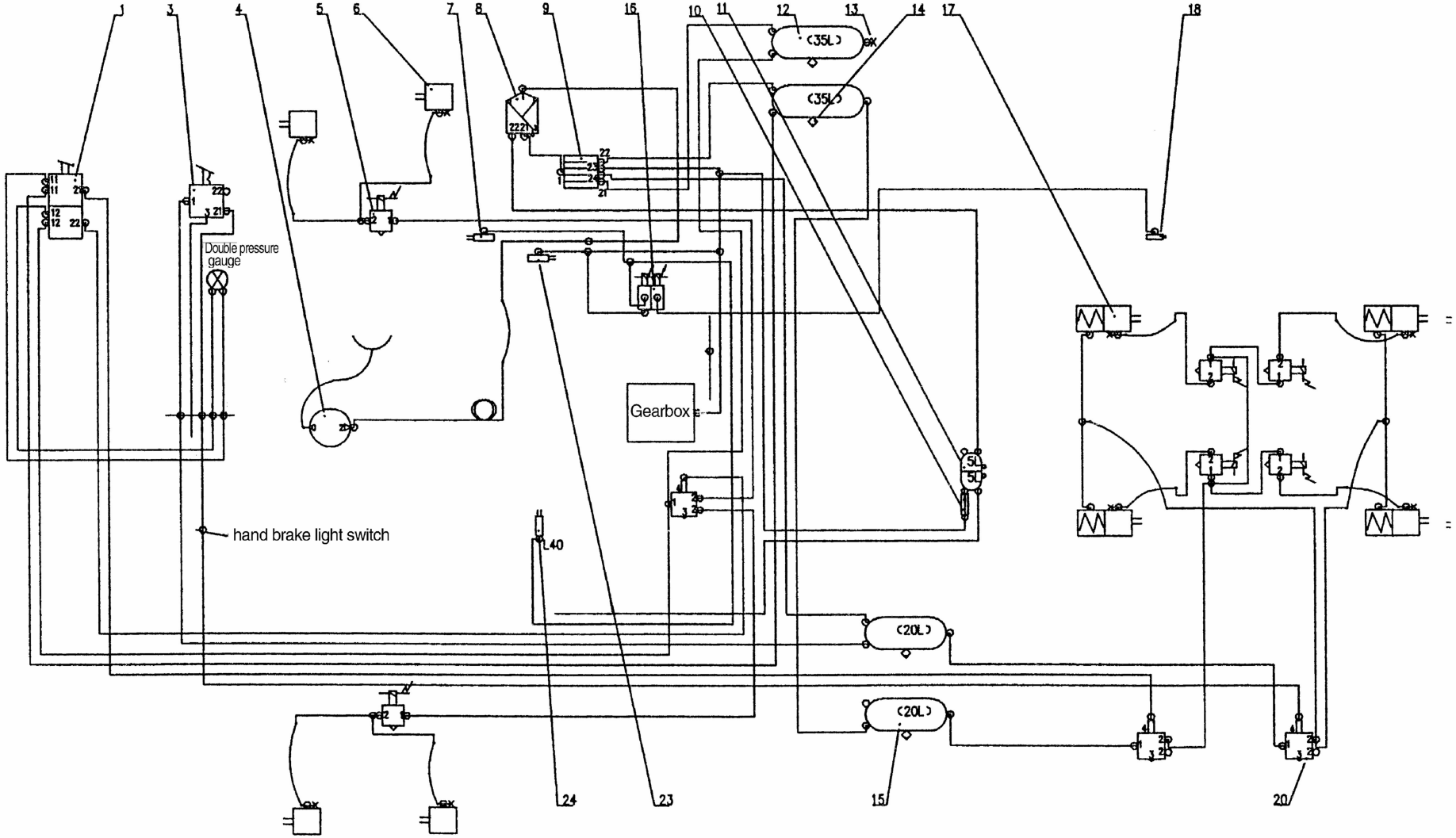
Fig. 12-3 STEYR 4×2 Tractor braking system diagram



1. Main brake valve
2. Trailer hand brake valve
3. Hand brake valve
4. Compressor
5. ABS electromagnetic valve
6. Chamber brake cylinder
7. Fuel cutout cylinder
8. Air dryer
9. Four circuit protection valve
10. Return valve
11. 10L Air reservoir
12. 30L Air reservoir
13. Test head
14. Drain valve
15. 20L Air reservoir
16. Electro magnetic valve
17. Chamber spring brake cylinder
18. Oprating cylinder for diffrential lock
19. 35L reservoir
20. Relay valve
21. Trailer control valve
22. Daul return valve
23. Aux.cylinder for gear box shifting
24. Exhaust brake cylinder

Explanation for marks: 1/11/12 –– Air inlet, 2/21/22/23/24 –– Air outlet, 3 –– Breathing hole, 4/43 –– control port.

Fig. 12-4 HOWO 6×4 Tractor braking system diagram



1. Main brake valve
2. Trailer hand brake valve
3. Hand brake valve
4. Compressor
5. ABS electromagnetic valve
6. Chamber brake cylinder
7. Fuel cutout cylinder
8. Air dryer
9. Four circuit protection valve
10. Return valve
11. 10L Air reservoir
12. 30L Air reservoir
13. Test head
14. Drain valve
15. 20L Air reservoir
16. Electro magnetic valve
17. Chamber spring brake cylinder
18. Oprating cylinder for diffrential lock
19. 35L reservoir
20. Relay valve
21. Trailer control valve
22. Daul return valve
23. Aux.cylinder for gear box shifting
24. Exhaust brake cylinder

Explanation for marks: 1/11/12 –– Air inlet, 2/21/22/23/24 –– Air outlet, 3 –– Breathing hole, 4/43 –– control port.

Fig. 12-5 HOWO 8×4 Tractor braking system diagram

- In order to clearly express the braking air pipeline systemic relationship, Fig. 12-6 shows the air pipelines process block diagram for a STEYR 6×4 drive and 3-axle truck.
- Every series trucks are equipped with main braking system with twin circuit braking, parking brake and emergency brake systems with spring stored energy relief braking, as well as auxiliary braking system with exhaust braking.
- The so-called "twin circuit" main braking system means that the system is divided into two related yet independent circuits respectively for the front axle and the (middle) rear axle; when any circuit failure happens, the other circuit is able to work normally, thus ensuring braking reliability.
- As shown in Fig. 12-6, air compressor(1)forces the compressed air flow through dryer (2)，on which there is a pressure regulating valve restraining the maximum air pressure in entire system in range of 7.5~8 bar.
- Separated air flows from the dryer to the four circuit protecting valves(4), thus the entire vehicle air pipelines are divided into four circuits mutually related and independent. The function of the four circuit protecting valves is, for example, when any of the circuits incurs trouble (such as breakage and leakage), the other circuits will continue normal working and inflation.

- Front axle braking circuit:
- The air flow through the four circuit protecting valve outlet "21" inflates the braking air reservoir(5), and then flows to lower chamber inlet "12" of the main brake valve(8). When stepping down the brake pedal，the main brake valve is open, the air flows from outlet "22" to the front axle braking chamber(9). During braking, the pressure in the braking chamber is proportional to the main brake valve pedal travel. In case ABS solenoid valve is installed between the relay valve and the braking chamber, the operation air pressure delivered to the braking chamber is simultaneously controlled by the ABS device.
- (Middle) rear axle braking circuit
- The air flow through outlet "22" of the four circuit protecting valves inflates the (middle) rear braking air reservoir(6), then from the air reservoir to supply the main brake valve(8)'s upper chamber inlet "11"; then flows through the main brake valve's outlet "21" to the main braking relay valve(10). The relay valve is fed directively by air reservoir(6), it controls the relay valve when the main brake valve is activated; after the relay valve is opened, air pressure is delivered respectively to (middle) rear axle main braking chamber(11)in proportion to the brake pedal travel. The relay valve's function is to shorten the brake responding time, so as to realize "fast charging" and "fast discharging".

The (middle) rear axle braking chamber is an one piece housing both for the main brake and the parking brake. Cross-pointer barometer(7)bridges the front brake air reservoir and (middle) rear brake air reservoir, so respectively indicates air pressure values in the two air reservoirs. In case ABS solenoid valve is installed between the relay valve and the braking chamber, the operation air pressure delivered to the braking chamber is simultaneously controlled by the ABS device.

- Parking brake circuit:
- From the four circuit protecting valve outlet "24", one pipeline is led to air reservoir(13), the other pipeline to hand brake valve (parking brake valve)(14) and hand braking relay valve(15). The hand brake valve controls the hand braking relay valve; when park braking, the relay valve's controlling air pressure is discharged by the hand brake valve; air from the hand braking chamber on the (middle) rear axle braking chamber flows out through the relay valve; spring in the chamber forces the piston and tappet to extend and thus to bring about braking effect; the braking intensity depends upon the pre-tightening force of the energy-store spring. When

parking brake valve is at "travel" position，the hand brake valve provides the relay valve, quickly enters the hand braking chamber of the (middle) rear axle braking chamber. If the pressed air is over 5.5 bar, it will overcome the spring force and force the piston to retract together with the tappet rod and thus to cancel the braking.

- With regard to the tractor，the twin-pipeline trailer brake valve(17)on the tractor is supplied by braking air reservoir(13)for inflation and braking pressure. Valve(17)is controlled respectively by the front, middle/rear unit of the main brake valve, and by parking brake valve. Some vehicle models are equipped separately with trailer hand brake valve 14a，which, together with the controlling air pressure from the main brake valve 21, and via a two-way check valve, parallelly control the trailer brake control valve. So long as any one of the controls functions, valve(17)will work, providing the trailer with a signal for braking pressure.

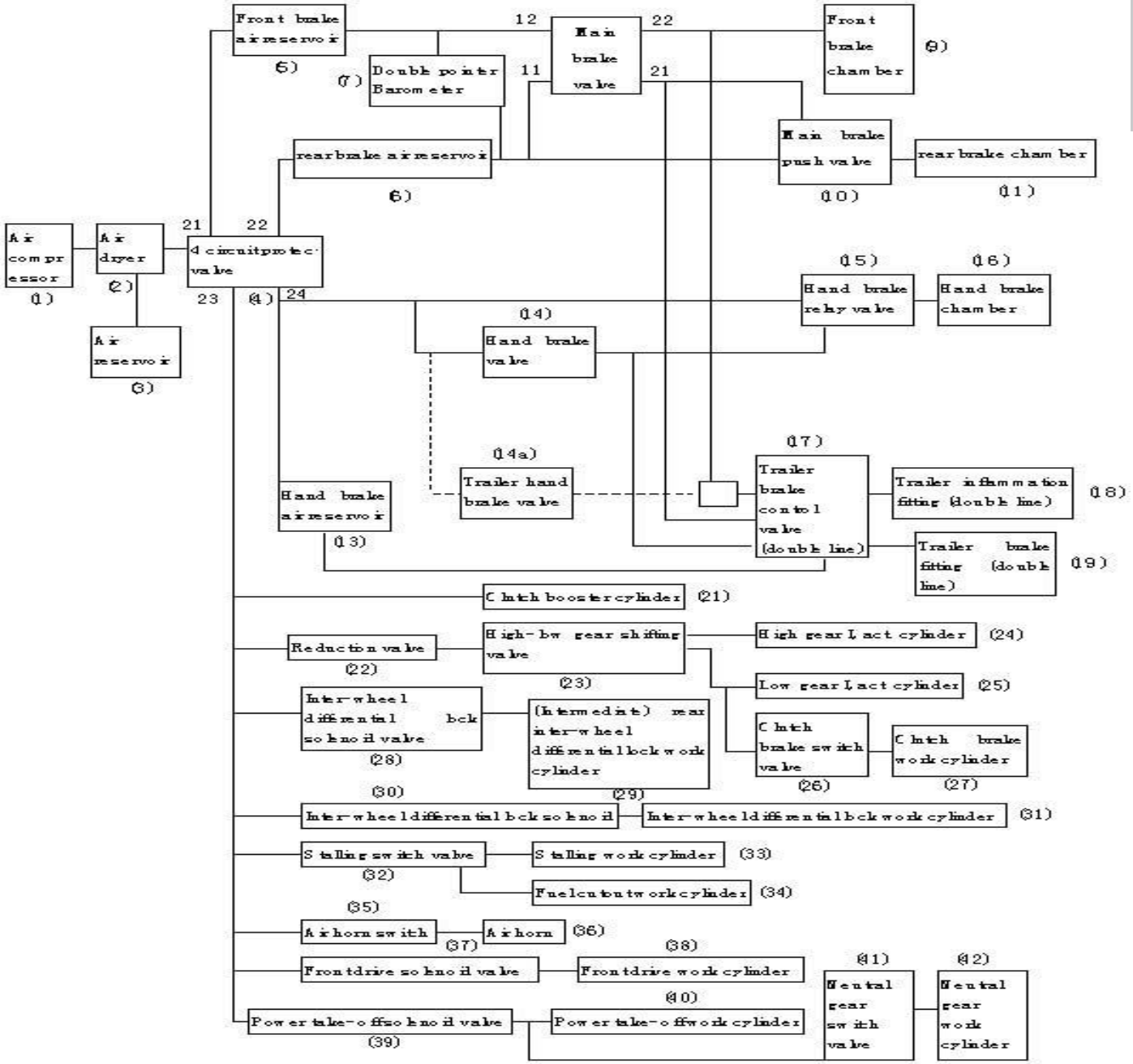


Fig. 12-6 Block diagram of the braking pipeline flow

- The twin pipeline control valve has two output pipelines, with one for inflation, constantly open, and usually in red; and the other a braking control pipeline, without air pressure when the tractor is running. Otherwise, when the tractor is in braking, it supplies a brake signal air pressure equal to the air pressure from the tractor main brake valve. The pipeline is usually in yellow.
- Fig. 12-7 shows a typical air pipeline system for a tractor with twin pipeline braking.

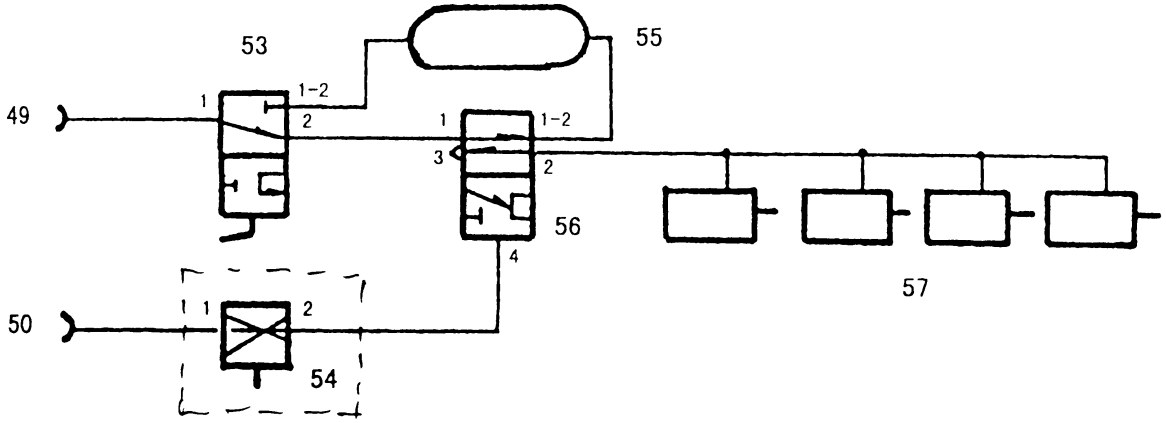


Fig. 12-7 Typical air pipeline system for a tractor with twin pipeline braking

- As shown in Fig. 12-7，when running normally, inflation is enabled through the charging line with charging connector 49, through trailer braking release valve 53 and trailer braking air reservoir 55. When braking the tractor, signal from the tractor braking control pipe joint 50 activates the trailer brake valve 56; some products from trailer manufacturers provide manually-operated load-control valve 54 between Nos. 50 and 56, opening a way from the trailer air reservoir to the braking chamber to enable the synchronized trailer to brake with the same intensity. Concurrent with this, the tractor keeps inflating the trailer air reservoir via inflation pipe. When canceling the tractor braking，control air pressure in the brake control pipelines exhausts to atmosphere by the control valve，and air in the trailer brake wheel cylinder exhausts to atmosphere by the trailer brake valve.
- In case of inflation pipe breakage or air leakage to a certain degree，the trailer brake valve will automatically turn to braking position. In case of brake control pipeline broken or leakage，there will be no influence for the tractor normal traveling; while when the tractor is in braking, the brake valve on the tractor will automatically cut out the charging line，thus enabling the trailer to brake via the trailer brake valve synchronously with the tractor braking.

- The function of release valve 53 is for relieving the trailer braking manually when the trailer is separated from the tractor and is in need to move. Some trailers are equipped with manual load valve，normally with three positions "zero load", " half load" and "full load" for manual operation to adjust the trailer braking intensity corresponding to braking force demand upon variation in load, and to satisfy improving the anti-lock braking effect on the trailer.
- Auxiliary Pressure Air Circuit:
- Any pressure air application other than for braking purpose is designed for connecting with the auxiliary pressure air circuit. As shown in Fig. 9-5，when stepping on the clutch pedal，the clutch boost valve(20)is activated to open the clutch boost cylinder(21)and to enable the booster.
- Reducer valve(22)reduces the air pressure down to 4.5 bar, the air flows to "double H" gear shifting valve(23)in the transmission; when the valve is in high gear position，the low gear cylinder(25)is in air returning, the high gear cylinder(24)is opened, so the transmission is in "high gears", to the opposite in "low gears". With regard to Fast transmission，when the transmission is in low speed，air pipelines are also open to clutch brake valve(26)，which opens when the vehicle starts running, and the clutch braking cylinder(27)is opened to enable the synchronizer start-up.

- Valve(28)is a wheel intermediate differential lock solenoid valve; after it is opened, the intermediate axle and rear axle differential lock working cylinder(29) is open and begins to move, the differential lock engages a gear and lockout.
- Valve(30)is an axle intermediate differential lock solenoid valve; after it is opened, the axle intermediate differential lock working cylinder(31) is open and begins to work, and thus to enable the axle intermediate differential lockout.
- Valve(32)is a turn-off switch. When a driver depresses it, the stalling cylinder(33)closes the engine exhaust pipe; the fuel cutoff cylinder (34)cuts off fuel for the injection pump, thus enabling the running vehicle exhaust to brake, and the stopped vehicle stalls.
- Valve(35)is an air horn switch，(36)is the air horn.
- As for all wheel drive vehicles, there is also a set of front axle differential lock solenoid valve(37)and working cylinder(38)，with the same function as that for the (intermediate) rear axle differential lock.
- With regard to self-dumping trucks，valve(39)is a power take off engaging solenoid valve. When it is open, working cylinder(40)is opened, the power take off engages and the self dumping power is connected. As for self-dumping trucks with Fast transmission，there is also a set of device with neutral switch(41)and neutral cylinder(42). As power take-off from Fast transmission is actually from the auxiliary shaft of the auxiliary transmission，when implementing power take-off, the main-gear box must be engaged, normally at 2nd gear in low gears, only in this way. This is one of the most different points in operation from other self-dumping

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trucks. Further more, when the power take-off is connected, if you operate the neutral switch 46 and open the neutral cylinder(42), the auxiliary transmission will be engaged at neutral，thus enabling the self-dumping truck to unload in situ. Without operating the neutral switch，the vehicle can perform unloading during traveling.

- Another point worth mentioning is that at every interface in the braking system air pipelines there is a number to indicate its application. The meanings of the numbers are as follows:
- “1”-inlet of the valve
- “2”——outlet of the valve
- “3”——ventilation port of the valve
- “4”——control port of the valve
- Any indication number with two digits will explain the interface sequence. For example,"11" can explain that it is the first air inlet of the valve; "12" indicates that it is the second air inlet; "21", the first outlet; "22", the second outlet, and so on. Symbol "+" and "-" are marked at interfaces of some valves. Interface marked with "+" indicates the proportional relation to the outlet air pressure; while if marked with "-", it means the inverse proportion to the outlet air pressure. For the convenience to identify them, the above-mentioned marks are attached to every air pipeline interface of every valve housing practically installed.